

# **Operations & Maintenance Cost Study for NASA Facilities**

## **Final Report for Propulsion Buildings**

**February 10, 2014**

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Contract NNC09BA14B

## **Operations & Maintenance Cost Study for NASA Facilities: Final Report for Propulsion Buildings**

### **Overview**

National Aeronautics and Space Administration (NASA) requires a credible method for estimating the operations and maintenance (O&M) requirements of its facilities.<sup>1</sup> The failure to anticipate future costs can lead to under-funding and diminished service life.

NASA has over 450 buildings totaling 12.6 million GSFT distributed at 24 sites in the selected inventory for this project. It is not cost effective to inspect all facilities, yet NASA needs detailed sustainment and operations estimates to support its budget planning. This project developed cost models for a sample of NASA assets with inventory details collected through site surveys. Estimates were extrapolated by facility type and size and adjusted for location to generate requirements for the selected NASA inventory.

The project employed the MARS Facility Cost Forecast System to provide cost information. Now in its eighth version, MARS is a facility cost modeling tool developed by CBRE | Whitestone and used by many federal and commercial agencies.

Phases 1 and 2 of this project called for inspections of four facility types: Administration Buildings, Propulsion Buildings, Communications Buildings, and Space Science (R&D and Test) Buildings. Eight sample buildings were chosen at two sites: the Goddard Space Flight Center (GSFC) and the Marshall Space Flight Center (MSFC).

Site inspections were conducted by Jacobs Facilities, a long-time CBRE | Whitestone partner experienced in inspecting federal facilities and creating MARS component inventories. A team of three, consisting of an architect, and electrical and mechanical engineers, carried out the facility inspections.

The project scope called for individual reports on two facility types, Administration and Propulsion Buildings. This report describes the project methodology and presents final estimates for the Propulsion Buildings in the NASA inventory.

### **Project Methodology**

#### **Parametric Estimates for Buildings**

The project methodology entailed estimating O&M requirements for the selected NASA inventory based on the inspection and modeling of a sample of facilities. The project included four key steps:

1. Validate the existing NASA inventory and develop a sample
2. Perform on-site inspections of the sample buildings
3. Develop and calibrate MARS models

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<sup>1</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mowing, and snow removal), security, telecommunications, and management. Maintenance (also known as sustainment) includes preventative maintenance, minor repair, unscheduled maintenance, and renewal and replacement.

4. Generate per square foot estimates of sustainment and operations costs for the sample and extrapolate to the project inventory

**Study Sample**

NASA has over 450 buildings at 24 sites globally in the selected inventory. Complete inspection of each site to estimate O&M requirements is impractical and costly. This project generated sustainment and operations estimates for a sample of buildings and extrapolated the costs to a selected NASA inventory.

The Statement of Work called for a sample that included one small building (approximately 10,000 square feet) and one large building (approximately 100,000 square feet) from four Classification types. The sample included two buildings from Administration Buildings, Propulsion Buildings, Communications Buildings, and Space Science (R&D and Test) Buildings. The project inventory excluded other Classification types in the NASA inventory, such as Warehouses and Wind Tunnels. CBRE | Whitestone proposed buildings at the Goddard Space Flight Center and the Marshall Space Flight Center to minimize travel costs.

Table 1 shows the building detail for the inspected Propulsion Buildings.

| Table 1. Propulsion Buildings Inspection Sample |                      |             |  |            |                |                     |
|---|----------------------|-------------|--|------------|----------------|---------------------|
| Site  | Classification       | Property ID | Property Name                          | Year Built | Size           | CRV                 |
| Marshall Space Flight Center                    | Propulsion Buildings | 1045/62/268 | MATERIALS COMBUSTION RESEARCH FACILITY | 1960       | 15,211         | \$6,713,582         |
|   | Propulsion Buildings | 1045/62/346 | PROPULSION RESEARCH & DEVELOPMENT LAB  | 2005       | 110,279        | \$21,781,307        |
| <b>Total</b>                                    |                      |             |  |            | <b>125,490</b> | <b>\$28,494,889</b> |

There are a number of variables that drive O&M costs. The project sampling plan only controls for size and Classification type. An alternative sample may control for current replacement value (CRV), age, and location.

The inspected sample was mapped to the remaining inventory by size and type. The 15k gross square foot (GSFT) building was mapped to the smaller half of the inventory, while the 110k GSFT building was mapped to the larger half. Square foot estimates were generated by MARS and then extrapolated to the inventory. All costs were indexed for location.

Propulsion Buildings represent 13.8 percent of the selected NASA inventory, totaling 1.7 million GSFT and 94 buildings with a \$1.7 billion CRV. Table 2 shows the Propulsion Buildings inventory by Site.

| <b>Table 2. NASA Propulsion Buildings by Site</b> |              |                  |                        |
|---|--------------|------------------|------------------------|
| <b>Site</b>                                       | <b>Count</b> | <b>Size</b>      | <b>CRV</b>             |
| AMES Research Center                              | 1            | 3,000            | \$12,285,153           |
| Glenn Research Center                             | 33           | 1,126,164        | \$1,079,767,487        |
| Goddard Space Flight Center                       | 7            | 7,747            | \$1,518,141            |
| Johnson Space Center                              | 14           | 64,064           | \$48,485,585           |
| Kennedy Space Center                              | 4            | 35,742           | \$53,981,698           |
| Langley Research Center                           | 4            | 73,188           | \$78,396,723           |
| Marshall Space Flight Center                      | 8            | 149,412          | \$50,739,330           |
| NASA/JSC/White Sands Test Facility                | 4            | 4,518            | \$3,076,829            |
| Plum Brook Station                                | 17           | 258,149          | \$326,145,882          |
| Stennis Space Center                              | 2            | 10,047           | \$2,408,263            |
| <b>Total</b>                                      | <b>94</b>    | <b>1,732,031</b> | <b>\$1,656,805,091</b> |

Detailed cost models were developed for the two buildings using CBRE | Whitestone’s MARS Facility Cost Forecast System.

### Description of the MARS Model

CBRE | Whitestone used MARS to estimate preventative maintenance, unscheduled maintenance, repair, and renewal/replacement costs for this project. MARS is an asset management system that estimates both deferred maintenance and future requirements on the basis of asset components and their scheduled maintenance and repair. It also estimates costs for ten operations types in the typical commercial chart of accounts. MARS was originally developed in 1996, and is currently in its eighth version. It is used by many government agencies and commercial concerns.

|                    |  |
|--------------------|--|
| <b>Sustainment</b> | Preventive Maintenance & Minor Repair<br>Unscheduled Maintenance<br>Renewal & Replacement                                      |
| <b>Operations</b>  | Custodial<br>Energy<br>Grounds<br>Management<br>Pest Control<br>Refuse<br>Road Clearance<br>Security<br>Telecom<br>Water/Sewer |

Note that the definition of future M&R requirements is the same as the “sustainment” requirements used for programming by DoD and an approach endorsed in a National Research Council (NRC) study of Department of Energy facility practices.<sup>2</sup> Among other agencies, the MARS Facility Cost Forecast System has been used to forecast budgets for the IRS, FAA, USDA, and CDC. It was recently used to benchmark costs for the Department of State Overseas Embassies. MARS is also the basis for the DoD Sustainment Model and a study for NNSA validating total life-cycle facility costs at eight nuclear weapons production and research sites.<sup>3</sup> The model is used continuously to simulate alternative facility costs for the U.S. nuclear complex.

The MARS process begins with a component inventory of a building or structure. Derived from building plans, equipment inventory data, and on-site inspections, these components are organized into UNIFORMAT category level three elements and are identified specifically in terms of product characteristics, quantity, and output level; e.g. “Single-Ply Modified Bituminous/Thermoplastic Roof,” “Condenser, Air-Cooled, 60 Ton,” or “Pipe & Fittings, ¾” Copper.”

Once the component inventory is completed, the MARS system relates maintenance tasks from a pre-defined task library to each selected component. New components and related tasks are defined as necessary. The frequency of each task determines the forecast of future required maintenance. MARS estimates four types of maintenance: preventative maintenance, unscheduled maintenance (service calls), repair, and renewal/replacement tasks. Tasks and their labor and material requirements are pre-defined by CBRE | Whitestone, but are also editable.

Other calibration steps include modifying default values for contract and in-house labor rates, specifying site-typical mark-up for contract expenditures, and identifying the utilization characteristics for each asset.

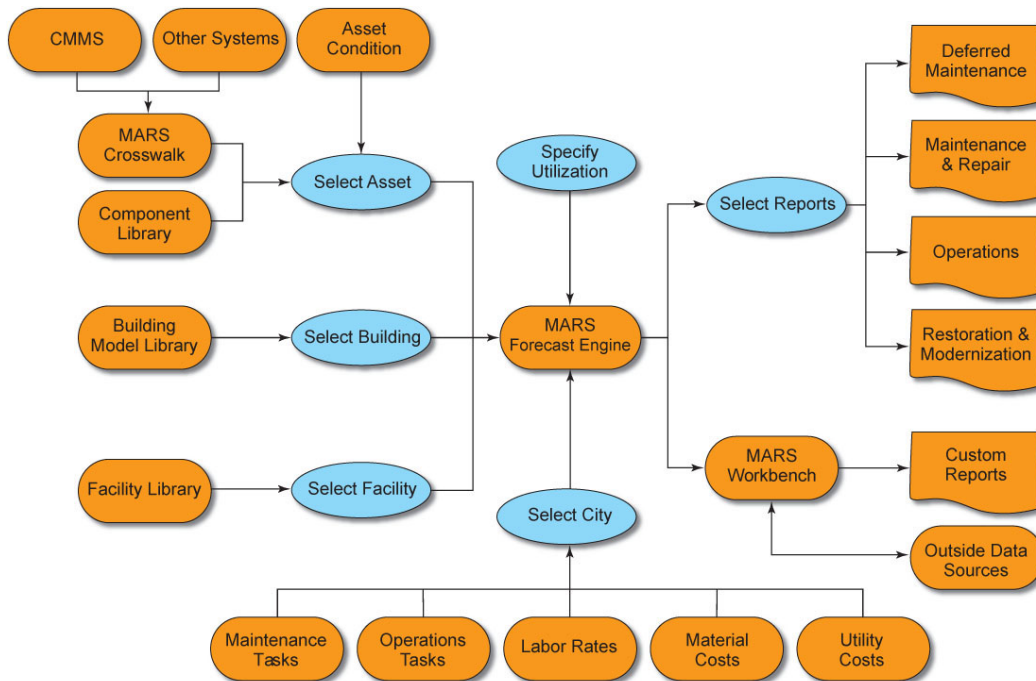
The sources for local wage rates and benefits are primarily the U.S. Department of Labor and Davis-Bacon Act labor agreements, and private sector employers. Both union and non-union wages are considered in determining prevailing rates by locality. State and local wage surveys are also used when available.

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<sup>2</sup> National Research Council, *Intelligent Sustainment and Renewal of Department of Energy Facilities and Infrastructure*, 2004. P. 44.

<sup>3</sup> Jacobs Facilities and Whitestone Research, *Implementation of the Department of Defense Sustainment Model, Final Report*, May 2002.

## MARS Facility Cost Forecast System



MARS is also used to estimate operations costs other than maintenance and repair. These are based on the Facilities Operation Model developed jointly by the Department of Defense (DOD) and CBRE | Whitestone. This model provides costs for ten services, including those mentioned in the Federal Real Property Council (FRPC) guidance—utilities, cleaning and janitorial, and roads and grounds.<sup>4</sup> Each operation type for an asset can be calibrated for a level of service (low, medium, high) to reflect the level of demand or frequency at which certain operations task are performed.

The CBRE | Whitestone operations cost models provides estimates for the following services:

**Custodial.** The custodial function represents the expense of cleaning offices, work areas, restrooms and common areas. Costs include local wage rates and benefits, task productivity, mark-ups for equipment, materials, supervision, and assumptions concerning the level of service. Trash removal costs are not included. Custodial service levels are defined by altering the combination and frequency of common tasks.

**Energy.** Energy includes all expenses related to the purchase, generation, distribution, and conservation of energy and source fuels necessary to operate an asset. The main energy sources considered are electricity and natural gas. Not included are utilities maintenance and supervision, and utility tax rates. Service levels vary according to estimated commodity demand by asset use type.

**Grounds.** The grounds function includes any expense related to the maintenance of exterior landscaping. It does not include sweeping or the maintenance of signage,

<sup>4</sup> Federal Real Property Council. *Guidance for Real Property Inventory Reporting*. Washington, D.C. August, 2012.

parking lots and roadways. Costs are estimated using local wage rates and benefits, task productivity, mark-ups for equipment, materials and supervision, and assumptions concerning the level of service. Service levels are defined by altering the combination and frequency of common tasks.

**Management.** The real property management function describes all costs associated with facility management, including: public works, contracts, material procurement, facility data, furnishings, real estate, and engineering services. Costs are expressed as a fixed percentage of Plant Replacement Value. Service levels are based on the distribution of costs found in institutional and commercial settings. For this project, the level of service for all NASA buildings was set to low to reflect economies of scale in a campus environment.

**Pest Control.** Pest control expenses cover indoor and outdoor pest control programs, separate from the grounds function. Costs are based on the frequency of common tasks for rodent and insect abatement and inspections. Costs include prevailing labor and material rates. Service levels are defined by altering the combination and frequency of common tasks.

**Refuse.** Refuse costs include all expenses related to trash collection and disposal, pick-up services, fees, recycling operations and administration, composting, etc. Costs exclude handling and disposal of HAZMAT materials. Service levels vary according to estimated demand by asset use type.

**Road Clearance.** The road clearance function includes all expenses related to sweeping paved areas including sidewalks, walkways, and parking lots. Costs include prevailing labor and material rates, and climatic variables. Service levels are defined by altering the combination and frequency of common tasks.

**Security.** Security expenses relate to the physical security of assets and occupants, and include personnel, operating and monitoring security equipment. Costs include relevant prevailing labor and material rates. Service levels are defined by altering the combination and frequency of common tasks and services.

**Telecommunications.** Telecommunication expenses cover the purchase of all the services ordinarily associated with commercial activities, such as voice and data equipment and service subscription. The level of telecommunications is defined by the combination of services selected.

**Water and Sewer.** Water and Sewer expenses include all costs related to providing the asset with potable water, irrigation water, and sewage service. Estimates include local commodity costs. Service levels vary according to estimated commodity demand by asset use type.

## Data Collection and Calibration

### MARS Model Development

The technical work for this task involved the definition of the component inventory for the two sample Propulsion Buildings. Marshall Space Flight Center staff supplied existing equipment inventories and construction design documents before the inspection. Jacobs Facilities inspected the buildings and created draft models in MARS. In total, 385 MARS components were defined for the two facilities.

Jacobs submitted the MARS database to CBRE | Whitestone for a detailed component-by-component review. Three areas of focus included:

- 1) Check for completeness. Review the wall finishes (exterior and interior), roofing, plumbing, HVAC, fire protection, and electrical data to ensure the building model contains the appropriate components in each category.
- 2) Check for consistency. Review the building gross square feet for accuracy. Ensure the square footage of structural components (exterior walls, roofing system, interior finishes) are reasonable compared to building GSFT. Verify the capacity of the following is consistent with the building type and size:
  - Heating, cooling, and air distribution
  - Electrical service, distribution, and lighting
  - Plumbing fixtures and water distribution
  - Fire protection
- 3) Forecast review. Run the following building-level MARS reports and look for extraordinary costs (high or low) illustrating an error in the building model:
  - Average M&R Costs
  - Most Costly M&R Tasks
  - Deferred Maintenance Detail
  - Operation Cost Summary

We also compared the costs with known resources (*The Whitestone Facility Maintenance and Repair* and *Operations Cost References*, comparable CBRE | Whitestone project work with federal agencies, and third party sources).

Attachment A and B provide detailed MARS component lists for the two inspected Propulsion Buildings at MSFC.

CBRE | Whitestone also collected information to calibrate the models for local site values.



## Local Calibration of MARS

While the MARS system has pre-defined building models, labor and material costs, utility rates, and an extensive component library, all of these values can be changed or supplemented to reflect the actual site practices.

Calibration data was gathered to adjust MARS factors at both the site and the building level. Site-level information, such as labor and utility rates, was directly used to estimate O&M costs for the remaining non-inspected buildings at GSFC and MSFC.

Building-level calibration data was applied to the sample models and then extrapolated to the remaining NASA inventory by Classification type and size.

The following data was collected to calibrate the building models:

Maintenance and Repair. The sites provided contract labor rates and labor rate mark-ups. A default assumption in MARS assigns in-house labor to preventative maintenance, minor repair, and unscheduled maintenance, while contract labor performs major repair and replacement tasks. Goddard Space Flight Center and the Marshall Space Flight Center staff indicated all maintenance was performed by contract laborers. CBRE | Whitestone adjusted the MARS database accordingly.

NASA personnel specified laborers must be paid prevailing wages for the area. We used the default MARS wage rates for this study, and included a 30 percent mark-up for contract overhead.

Table 3 shows the source of the maintenance and repair factors for each site.

| <b>Table 3. Data Sources by Site, Maintenance &amp; Repair</b> |                            |                              |                             |                                |                    |
|--|----------------------------|------------------------------|-----------------------------|--------------------------------|--------------------|
| <b>Site</b>  | <b>In-house Shop Rates</b> | <b>In-house Markup Rates</b> | <b>Contract Labor Rates</b> | <b>Contract Overhead Rates</b> | <b>Utilization</b> |
| Goddard Space Flight Center                                    | N/A                        | N/A                          | WST                         | WST                            | Site               |
| Marshall Space Flight Center                                   | N/A                        | N/A                          | WST                         | WST                            | Site               |
| WST=Whitestone, Site = Respective NASA Site                    |                            |                              |                             |                                |                    |

MARS estimates also can be adjusted to reflect utilization factors that impact M&R. For example, many NASA facilities have special safety requirements which increase costs relative to conventional commercial practice. Other special requirements include high or low hours of operation and security. The two sites defined utilization factors for the eight buildings.

Table 4 displays the average utilization multipliers by site used to adjust for these requirements.

| Table 4. Average Utilization Adjustment by Site <sup>A</sup> |                                 |                       |                                  |                  |
|--|---------------------------------|-----------------------|----------------------------------|------------------|
| Site   | Hours of Operation <sup>B</sup> | Security <sup>C</sup> | Safety & Permitting <sup>D</sup> | Sum <sup>E</sup> |
| Goddard Space Flight Center                                  | 1.37                            | 1.05                  | 1.04                             | 1.45             |
| Marshall Space Flight Center                                 | 1.07                            | 1.01                  | 1.03                             | 1.11             |

<sup>A</sup> Calculated from individual asset multipliers assigned by the sites.  
<sup>B</sup> Hours of Operation rates building use on a weekly basis and is defined as follow s: 0.80 = 40 hours, 1.00 = 41 to 80 hours, 1.37 = 80+ hours.  
<sup>C</sup> Security is defined as follow s: 1.00 = free access, 1.01 = contractor training & daily check-in, 1.15 = full contractor accompaniment.  
<sup>D</sup> Safety & Permitting is defined as follow s: 1.00 = typical commercial & service activity, 1.07 = non-specific laboratory, 1.75 = radiological or life science research, 3.00 = nuclear facility.  
<sup>E</sup> In combination the multipliers are additive such that the total multiplier =  $1 + \sum (\beta - 1)$  w here  $\beta$  = the multiplier value.

**Operations.** MARS also estimates operations costs for ten services including: custodial, energy, grounds, management, pest control, refuse, road clearance, security, telecommunications, and water & sewer. We requested utility rates, operations labor rates, and mark-ups. In addition, individual building models are calibrated in terms of level of service (low, medium, high, or none).

Each site defined levels of service for all operation types and provided several utility rates. As with M&R, CBRE | Whitestone used the default MARS wage rates and a 30 percent mark-up for contract overhead.

The utility rates provided by the two sites were significantly lower than the default MARS commercial rates. These discounts are often provided to large federal property holders like NASA. CBRE | Whitestone applied the average discounts for the calibrated sites (GSFC and MSFC) to the remaining sites in the inventory.

Table 5 shows the source of the operations calibration data.

| Table 5. Data Sources by Site, Operations |                  |                |              |              |                   |                    |                   |                     |                |                     |               |
|---|------------------|----------------|--------------|--------------|-------------------|--------------------|-------------------|---------------------|----------------|---------------------|---------------|
| Site                                      | Level of Service | Custodial Wage | Refuse Rates | Energy Rates | Water/Sewer Rates | Groundskeeper Wage | Pest Control Wage | Road Clearance Wage | Security Rates | Property Management | Telecom Rates |
| Goddard Space Flight Center               | Site             | WST            | Site         | Site         | Site              | WST                | WST               | WST                 | WST            | Site                | WST           |
| Marshall Space Flight Center              | Site             | WST            | WST          | Site         | Site              | WST                | WST               | WST                 | WST            | Site                | WST           |

WST=Whitestone, Site = Respective NASA Site

## Cost Estimates for Propulsion Buildings

### Sustainment Costs

The final sustainment estimate for the smaller MSFC Propulsion Building (Property ID 1045/62/268) is an average of \$8.22 per GSFT over a 50-year period. The larger building (Property ID 1045/62/346) is \$4.31 per GSFT over the same period.

The sample estimates were extrapolated to the population. Table 6 shows sustainment costs by site for all Propulsion Buildings. Sustainment estimates are expressed as 30, 40, and 50-year averages. While CBRE | Whitestone computes annual requirements, average costs are presented to smooth the annual oscillations. Overall, the sustainment requirements are an average of \$12.1 million per year over 50 years, or \$6.99 per GSFT. Expressed another way, this amounts to 0.7 percent of the \$1.7 billion replacement value.

**Table 6. Average Annual Estimates of Sustainment Requirements by Site, Propulsion Buildings**

| Site                               | GSFT             | CRV                    | Sustainment <sup>A</sup> |               |             |                      |               |             |                      |               |             |
|------------------------------------|------------------|------------------------|--------------------------|---------------|-------------|----------------------|---------------|-------------|----------------------|---------------|-------------|
|                                    |                  |                        | 30-Year Estimates        |               |             | 40-Year Estimates    |               |             | 50-Year Estimates    |               |             |
|                                    |                  |                        | Avg. Annual Estimate     | Per GSFT      | Percent CRV | Avg. Annual Estimate | Per GSFT      | Percent CRV | Avg. Annual Estimate | Per GSFT      | Percent CRV |
| AMES Research Center               | 3,000            | \$12,285,153           | \$38,398                 | \$12.80       | 0.3%        | \$36,555             | \$12.18       | 0.3%        | \$36,151             | \$12.05       | 0.3%        |
| Glenn Research Center              | 1,126,164        | \$1,079,767,487        | \$8,138,567              | \$7.23        | 0.8%        | \$7,854,470          | \$6.97        | 0.7%        | \$7,773,799          | \$6.90        | 0.7%        |
| Goddard Space Flight Center        | 7,747            | \$1,518,141            | \$82,064                 | \$10.59       | 5.4%        | \$78,125             | \$10.08       | 5.1%        | \$77,262             | \$9.97        | 5.1%        |
| Johnson Space Center               | 64,064           | \$48,485,585           | \$607,240                | \$9.48        | 1.3%        | \$578,093            | \$9.02        | 1.2%        | \$571,704            | \$8.92        | 1.2%        |
| Kennedy Space Center               | 35,742           | \$53,981,698           | \$284,735                | \$7.97        | 0.5%        | \$271,068            | \$7.58        | 0.5%        | \$268,072            | \$7.50        | 0.5%        |
| Langley Research Center            | 73,188           | \$78,396,723           | \$643,150                | \$8.79        | 0.8%        | \$612,279            | \$8.37        | 0.8%        | \$605,512            | \$8.27        | 0.8%        |
| Marshall Space Flight Center       | 149,412          | \$50,739,330           | \$829,911                | \$5.55        | 1.6%        | \$804,803            | \$5.39        | 1.6%        | \$796,757            | \$5.33        | 1.6%        |
| NASA/JSC/White Sands Test Facility | 4,518            | \$3,076,829            | \$36,356                 | \$8.05        | 1.2%        | \$34,611             | \$7.66        | 1.1%        | \$34,228             | \$7.58        | 1.1%        |
| Plum Brook Station                 | 258,149          | \$326,145,882          | \$1,946,905              | \$7.54        | 0.6%        | \$1,875,358          | \$7.26        | 0.6%        | \$1,855,893          | \$7.19        | 0.6%        |
| Stennis Space Center               | 10,047           | \$2,408,263            | \$87,720                 | \$8.73        | 3.6%        | \$83,510             | \$8.31        | 3.5%        | \$82,587             | \$8.22        | 3.4%        |
| <b>Total<sup>B</sup></b>           | <b>1,732,031</b> | <b>\$1,656,805,091</b> | <b>\$12,695,045</b>      | <b>\$7.33</b> | <b>0.8%</b> | <b>\$12,228,872</b>  | <b>\$7.06</b> | <b>0.7%</b> | <b>\$12,101,963</b>  | <b>\$6.99</b> | <b>0.7%</b> |

<sup>A</sup> Sustainment is the average annual sum of preventative maintenance, unscheduled maintenance, and major repair and replacement tasks.

<sup>B</sup> All costs expressed in \$2012.

### Operation Costs

Final estimates of ten operation costs are shown in Table 7. In total, the operation requirements for the selected Propulsion Buildings are an annual average of \$12.2 million, or \$7.05 per GSFT and 0.7 percent of replacement value. Note that in commercial accounting M&R (sustainment) is often included as an operating cost, but is reported separately above.

| Site                               | Operations Type <sup>A</sup> |                        |                    |                    |                  |                    |                  |                 |                  |                    |                  |                  |                     | Total Costs   | Per GSFT    | Percent CRV |
|------------------------------------|------------------------------|------------------------|--------------------|--------------------|------------------|--------------------|------------------|-----------------|------------------|--------------------|------------------|------------------|---------------------|---------------|-------------|-------------|
|                                    | GSFT                         | CRV                    | Custodial          | Energy             | Grounds          | Management         | Pest Control     | Refuse          | Road Clearance   | Security           | Telecom          | Water/Sewer      |                     |               |             |             |
| AMES Research Center               | 3,000                        | \$12,285,153           | \$2,452            | \$9,226            | \$524            | \$30,713           | \$447            | \$109           | \$0              | \$2,940            | \$1,243          | \$567            | \$48,222            | \$16.07       | 0.4%        |             |
| Glenn Research Center              | 1,126,164                    | \$1,079,767,487        | \$823,983          | \$2,333,724        | \$119,763        | \$2,699,419        | \$88,754         | \$9,989         | \$90,197         | \$769,785          | \$645,146        | \$276,699        | \$7,857,458         | \$6.98        | 0.7%        |             |
| Goddard Space Flight Center        | 7,747                        | \$1,518,141            | \$6,932            | \$25,607           | \$974            | \$3,795            | \$1,057          | \$255           | \$120            | \$8,034            | \$3,210          | \$2,598          | \$52,583            | \$6.79        | 3.5%        |             |
| Johnson Space Center               | 64,064                       | \$48,485,585           | \$37,518           | \$170,947          | \$7,791          | \$121,214          | \$6,054          | \$1,940         | \$0              | \$57,350           | \$26,546         | \$13,499         | \$442,859           | \$6.91        | 0.9%        |             |
| Kennedy Space Center               | 35,742                       | \$53,981,698           | \$20,541           | \$112,144          | \$4,426          | \$134,954          | \$3,624          | \$1,128         | \$0              | \$31,851           | \$14,810         | \$9,316          | \$332,794           | \$9.31        | 0.6%        |             |
| Langley Research Center            | 73,188                       | \$78,396,723           | \$45,602           | \$181,014          | \$8,042          | \$195,992          | \$7,577          | \$2,285         | \$444            | \$66,894           | \$30,327         | \$11,511         | \$549,687           | \$7.51        | 0.7%        |             |
| Marshall Space Flight Center       | 149,412                      | \$50,739,330           | \$95,807           | \$371,878          | \$18,734         | \$126,848          | \$9,999          | \$4,959         | \$342            | \$95,935           | \$90,949         | \$13,569         | \$829,019           | \$5.55        | 1.6%        |             |
| NASA/JSC/White Sands Test Facility | 4,518                        | \$3,076,829            | \$2,802            | \$11,621           | \$434            | \$7,692            | \$450            | \$71            | \$32             | \$4,075            | \$1,872          | \$251            | \$29,299            | \$6.49        | 1.0%        |             |
| Plum Brook Station                 | 258,149                      | \$326,145,882          | \$188,386          | \$552,981          | \$27,453         | \$815,365          | \$20,345         | \$2,290         | \$20,676         | \$183,260          | \$143,663        | \$63,427         | \$2,017,844         | \$7.82        | 0.6%        |             |
| Stennis Space Center               | 10,047                       | \$2,408,263            | \$6,932            | \$28,768           | \$1,188          | \$6,021            | \$828            | \$293           | \$0              | \$9,352            | \$4,163          | \$964            | \$58,509            | \$5.82        | 2.4%        |             |
| <b>Total<sup>B</sup></b>           | <b>1,732,031</b>             | <b>\$1,656,805,091</b> | <b>\$1,230,954</b> | <b>\$3,797,909</b> | <b>\$189,329</b> | <b>\$4,142,013</b> | <b>\$139,134</b> | <b>\$23,319</b> | <b>\$111,810</b> | <b>\$1,229,475</b> | <b>\$961,930</b> | <b>\$392,402</b> | <b>\$12,218,274</b> | <b>\$7.05</b> | <b>0.7%</b> |             |

<sup>A</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mowing, and snow removal), security, telecommunications, and management.  
<sup>B</sup> All costs expressed in \$2012.

## Total O&M Costs

Estimated total annual Propulsion Building costs are shown in Table 8. A combination of maintenance and repair (sustainment) and operations, these costs represent an annual average for the next 50 years. Total costs are an estimated \$24.3 million per year, or can also be expressed as \$14.04 per GSFT and 1.5 percent of CRV.

| Site                               | GSFT             | CRV                    | O&M Estimates                         |                                | Total Costs         | Per GSFT       | Percent CRV |
|------------------------------------|------------------|------------------------|---------------------------------------|--------------------------------|---------------------|----------------|-------------|
|                                    |                  |                        | 50-Year Avg. Sustainment <sup>A</sup> | Annual Operations <sup>B</sup> |                     |                |             |
| AMES Research Center               | 3,000            | \$12,285,153           | \$36,151                              | \$48,222                       | \$84,373            | \$28.12        | 0.7%        |
| Glenn Research Center              | 1,126,164        | \$1,079,767,487        | \$7,773,799                           | \$7,857,458                    | \$15,631,256        | \$13.88        | 1.4%        |
| Goddard Space Flight Center        | 7,747            | \$1,518,141            | \$77,262                              | \$52,583                       | \$129,845           | \$16.76        | 8.6%        |
| Johnson Space Center               | 64,064           | \$48,485,585           | \$571,704                             | \$442,859                      | \$1,014,563         | \$15.84        | 2.1%        |
| Kennedy Space Center               | 35,742           | \$53,981,698           | \$268,072                             | \$332,794                      | \$600,866           | \$16.81        | 1.1%        |
| Langley Research Center            | 73,188           | \$78,396,723           | \$605,512                             | \$549,687                      | \$1,155,199         | \$15.78        | 1.5%        |
| Marshall Space Flight Center       | 149,412          | \$50,739,330           | \$796,757                             | \$829,019                      | \$1,625,776         | \$10.88        | 3.2%        |
| NASA/JSC/White Sands Test Facility | 4,518            | \$3,076,829            | \$34,228                              | \$29,299                       | \$63,528            | \$14.06        | 2.1%        |
| Plum Brook Station                 | 258,149          | \$326,145,882          | \$1,855,893                           | \$2,017,844                    | \$3,873,737         | \$15.01        | 1.2%        |
| Stennis Space Center               | 10,047           | \$2,408,263            | \$82,587                              | \$58,509                       | \$141,095           | \$14.04        | 5.9%        |
| <b>Total<sup>C</sup></b>           | <b>1,732,031</b> | <b>\$1,656,805,091</b> | <b>\$12,101,963</b>                   | <b>\$12,218,274</b>            | <b>\$24,320,237</b> | <b>\$14.04</b> | <b>1.5%</b> |

<sup>A</sup> Sustainment is the average annual sum of preventative maintenance, unscheduled maintenance, and major repair and replacement tasks.  
<sup>B</sup> Operations include custodial (cleaning, pest control, and trash collection), utilities (energy, water, and sewer), grounds (landscape care, mowing, and snow removal), security, telecommunications, and management.  
<sup>C</sup> All costs expressed in \$2012.

Included in Attachment A and B are detailed MARS reports for the two sample Marshall Space Flight Center Propulsion Buildings.

**Attachment A: Detailed MARS Reports for MSFC Property ID  
1045/62/268**

# Building Component List

Whitestone Research

**Building:** Materials Combustion Research Facilit

**Year Built:** 1960

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/268

**City:** Huntsville, AL

**Replacement Value:** \$6,713,582 **per SF:** \$441

**Building Gsft:** 15,211

| Uniformat | Asset Description | Component   | Date | Quantity     | Location | Notes     |
|-----------|-------------------|---|------|--------------|----------|-----------|
| B2010     |                   | Aluminum Louver, 1st Floor                                | 1991 | 9 Each       |          |           |
| B2010     |                   | Clay Brick, Exterior, 1st Floor                           | 1960 | 6380 Sq Ft   |          |           |
| B2010     |                   | Concrete Block, Painted, Exterior, 1st Floor              | 1960 | 1060 Sq Ft   |          |           |
| B2010     |                   | Steel, Painted, Exterior, 2nd Floor                       | 1997 | 700 Sq Ft    |          |           |
| B2020     |                   | Aluminum Fixed Window, 24 sf, 1st Floor                   | 1960 | 2 Each       |          |           |
| B2030     |                   | Aluminum Frame, Fully Glazed, Exterior Door               | 1995 | 1 Each       |          |           |
| B2030     |                   | Aluminum Frame, Fully Glazed, Exterior Door               | 1991 | 2 Each       |          |           |
| B2030     |                   | Steel w/ Safety Glass, Painted, Exterior Door             | 1991 | 3 Each       |          |           |
| B2030     |                   | Steel, 10'x8', Painted, Overhead Coiling Door, Motorized  | 1990 | 4 Each       |          |           |
| B2030     |                   | Steel, 10'x8', Painted, Overhead Coiling Door, Motorized  | 1991 | 4 Each       |          |           |
| B2030     |                   | Steel, 14'x10', Painted, Overhead Coiling Door, Motorized | 1998 | 4 Each       |          |           |
| B2030     |                   | Steel, 14'x10', Painted, Overhead Coiling Door, Motorized | 1995 | 1 Each       |          |           |
| B2030     |                   | Steel, Painted, Exterior Door                             | 1991 | 3 Each       |          |           |
| B2030     |                   | Steel, Painted, Exterior Double Door                      | 1991 | 7 Each       |          |           |
| B3010     |                   | Aluminum Gutter, Downspouts, Fittings                     | 1997 | 0.85 K Ln Ft |          |           |
| B3010     |                   | Metal Roof  | 1997 | 18800 Sq Ft  |          |           |
| C1010     |                   | Toilet Partitions, Painted Metal, Overhead Braced         | 1994 | 3 Each       |          |           |
| C1020     |                   | Aluminum, Fully Glazed, Interior Door                     | 1995 | 1 Each       |          |           |
| C1020     |                   | Aluminum, Fully Glazed, Interior Door                     | 1991 | 2 Each       |          |           |
| C1020     |                   | Steel, Interior Door                                      | 1960 | 4 Each       |          | stainless |
| C1020     |                   | Steel, Painted, Interior Door                             | 1960 | 1 Each       |          |           |
| C1020     |                   | Steel, Painted, Interior Door                             | 1991 | 11 Each      |          |           |
| C1020     |                   | Steel, Painted, Interior Door                             | 1997 | 1 Each       |          |           |
| C1020     |                   | Steel, Painted, Interior Double Door                      | 1997 | 4 Each       |          |           |
| C1020     |                   | Steel, Painted, Interior Double Door w/ Safety Glass      | 1995 | 1 Each       |          |           |
| C1020     |                   | Steel, Painted, Interior Double Door w/ Safety Glass      | 1991 | 1 Each       |          |           |
| C1020     |                   | Steel, Painted, w/ Safety Glass, Interior Door            | 1991 | 2 Each       |          |           |
| C1020     |                   | Steel, Painted, w/ Safety Glass, Interior Door            | 1960 | 1 Each       |          |           |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

05-Mar-13

| Uniformat | Asset Description | Component  | Date | Quantity      | Location | Notes   |
|-----------|-------------------|--|------|---------------|----------|---------|
| C1020     |                   | Wood, Solid Core w/ Safety Glass, Painted, Interior Door | 1997 | 3 Each        |          |         |
| C1020     |                   | Wood, Solid Core w/ Safety Glass, Painted, Interior Door | 1991 | 1 Each        |          |         |
| C1020     |                   | Wood, Solid Core w/ Safety Glass, Painted, Interior Door | 1960 | 1 Each        |          |         |
| C1020     |                   | Wood, Solid Core, Painted, Interior Door                 | 1991 | 3 Each        |          |         |
| C1020     |                   | Wood, Solid Core, Painted, Interior Door                 | 1960 | 1 Each        |          |         |
| C1020     |                   | Wood, Solid Core, Painted, Interior Door                 | 1997 | 6 Each        |          |         |
| C2010     |                   | Metal, Painted, Interior Railing                         | 1991 | 50 Ln Ft      |          |         |
| C2010     |                   | Metal, Painted, Interior Stairs                          | 1991 | 36 Sq Ft      |          |         |
| C3010     |                   | Concrete Block, Painted, Interior Wall Finish            | 1960 | 20000 Sq Ft   |          |         |
| C3010     |                   | Concrete, Painted, Interior Wall Finish                  | 1960 | 5250 Sq Ft    |          |         |
| C3010     |                   | Gypsum Board, Interior Wall Finish                       | 1991 | 210 Sq Ft     |          |         |
| C3010     |                   | Plate Glass Interior Wall                                | 1960 | 10 Sq Ft      |          |         |
| C3020     |                   | Carpet, Nylon 20 oz., Low Traffic                        | 1997 | 1014 Sq Ft    |          |         |
| C3020     |                   | Carpet, Nylon 20 oz., Low Traffic                        | 1991 | 1035 Sq Ft    |          |         |
| C3020     |                   | Concrete Flooring  | 1960 | 3523 Sq Ft    |          |         |
| C3020     |                   | Concrete, Painted Flooring                               | 1960 | 2721 Sq Ft    |          |         |
| C3020     |                   | Epoxy Flooring   | 1997 | 1027 Sq Ft    |          |         |
| C3020     |                   | Metal Flooring   | 1960 | 518 Sq Ft     |          |         |
| C3020     |                   | Vinyl Tile Flooring                                      | 1997 | 3325 Sq Ft    |          |         |
| C3020     |                   | Vinyl Tile Flooring                                      | 1991 | 2721 Sq Ft    |          |         |
| C3030     |                   | Acoustical Tile, Dropped Ceiling                         | 1991 | 7700 Sq Ft    |          |         |
| C3030     |                   | Concrete, Painted Ceiling                                | 1960 | 2585 Sq Ft    |          |         |
| C3030     |                   | Gypsum Board, Finished Ceiling                           | 1991 | 430 Sq Ft     |          |         |
| C3030     |                   | Metal, Painted Ceiling                                   | 1960 | 2050 Sq Ft    |          |         |
| D1010     |                   | Hoist Electric, Overhead, Chain, 3 Ton                   | 1991 | 3 Each        |          | 2 -1Ton |
| D2010     |                   | Drinking Fountain, Refrigerated                          | 1991 | 1 Each        |          |         |
| D2010     |                   | Emergency Eye Wash                                       | 1991 | 1 Each        |          |         |
| D2010     |                   | Emergency Eye Wash & Shower Station                      | 1991 | 2 Each        |          |         |
| D2010     |                   | Lavatory, Vitreous China                                 | 1991 | 3 Each        |          |         |
| D2010     |                   | Shower, Ceramic Tile                                     | 1991 | 1 Each        |          |         |
| D2010     |                   | Sink, Stainless Steel                                    | 1991 | 3 Each        |          |         |
| D2010     |                   | Tankless Water Closet                                    | 1991 | 3 Each        |          |         |
| D2010     |                   | Urinal, Vitreous China                                   | 1991 | 1 Each        |          |         |
| D2020     |                   | Pipe & Fittings, 2" Copper, Cold Water                   | 1991 | 0.075 K Ln Ft |          |         |
| D2020     |                   | Pipe & Fittings, 3" Steel                                | 1960 | 0.05 K Ln Ft  |          |         |
| D2020     |                   | Pipe & Fittings, 3/4" Copper, Cold Water                 | 1991 | 0.4 K Ln Ft   |          |         |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component   | Date | Quantity      | Location | Notes |
|-----------|-------------------|---|------|---------------|----------|-------|
| D2020     |                   | Pipe & Fittings, 3/4" Copper, Hot Water           | 1991 | 0.35 K Ln Ft  |          |       |
| D2020     |                   | Pipe Insulation, Fiberglass, Cold Water           | 1991 | 0.45 K Ln Ft  |          |       |
| D2020     |                   | Pipe Insulation, Fiberglass, Hot Water            | 1991 | 0.3 K Ln Ft   |          |       |
| D2020     |                   | Water Heater, Electric, 30 Gal.                   | 1991 | 2 Each        |          |       |
| D2020     |                   | Water Heater, Electric, 52 Gal.                   | 1991 | 1 Each        |          |       |
| D2030     |                   | Backflow Preventer, 1"                            | 1991 | 1 Each        |          |       |
| D2030     |                   | Backflow Preventer, 2"                            | 1991 | 1 Each        |          |       |
| D2030     |                   | Floor Drain                                       | 1991 | 2 Each        |          |       |
| D2030     |                   | Pipe & Fittings, 2" PVC                           | 1991 | 0.075 K Ln Ft |          |       |
| D2030     |                   | Pipe & Fittings, 3" Cast Iron                     | 1960 | 0.25 K Ln Ft  |          |       |
| D2030     |                   | Pipe & Fittings, 4" Cast Iron                     | 1960 | 0.15 K Ln Ft  |          |       |
| D2030     |                   | Pipe & Fittings, 6" Cast Iron                     | 1960 | 0.05 K Ln Ft  |          |       |
| D2090     | BB567             | Air Compressor, 2 HP                              | 1997 | 1 Each        |          |       |
| D3020     |                   | Gate Valve, 2-3"                                  | 1997 | 11 Each       |          |       |
| D3030     |                   | Air Separator, 2"                                 | 1997 | 1 Each        |          |       |
| D3030     |                   | Chiller, Reciprocal Air-Cooled Hermetic, 10 Ton   | 1991 | 1 Each        |          |       |
| D3030     |                   | Chiller, Reciprocal Air-Cooled Hermetic, 60 Ton   | 1997 | 1 Each        |          |       |
| D3030     | P-02, 03          | Circulation Pump, 2 HP, Chiller & Condenser Water | 1997 | 2 Each        |          |       |
| D3030     | P-1A, 1B          | Circulation Pump, 5 HP, Chiller & Condenser Water | 1997 | 2 Each        |          |       |
| D3030     |                   | Expansion Tank, 30 Gal.                           | 1997 | 1 Each        |          |       |
| D3030     |                   | Flow Control Valve, Motorized, 1"                 | 1997 | 8 Each        |          |       |
| D3030     |                   | Flow Control Valve, Motorized, 2"                 | 1997 | 1 Each        |          |       |
| D3030     |                   | Pipe & Fittings, 1" Copper                        | 1991 | 0.175 K Ln Ft |          |       |
| D3030     |                   | Pipe & Fittings, 1" Steel                         | 1991 | 0.35 K Ln Ft  |          |       |
| D3030     |                   | Pipe & Fittings, 2" Steel                         | 1991 | 0.225 K Ln Ft |          |       |
| D3030     |                   | Pipe & Fittings, 3" Steel                         | 1997 | 0.325 K Ln Ft |          |       |
| D3030     |                   | Pipe Insulation, Fiberglass, Chilled Water        | 1991 | 0.9 K Ln Ft   |          |       |
| D3030     |                   | Pressure Reducer Valve, 1-1/2"                    | 1997 | 1 Each        |          |       |
| D3040     |                   | Air Handler, Single Zone, 2,500 Cfm               | 1991 | 2 Each        |          |       |
| D3040     | AHU-1             | Air Handler, Single Zone, 8,000 Cfm               | 1997 | 1 Each        |          |       |
| D3040     |                   | Duct Insulation, Fiberglass Blanket               | 1991 | 7000 Sq Ft    |          |       |
| D3040     |                   | Ductwork  | 1991 | 9800 Lbs      |          |       |
| D3040     |                   | Ductwork, Stainless Steel                         | 1997 | 250 Lbs       |          |       |
| D3040     |                   | Exhaust Fan, Centrifugal, 800 Cfm                 | 1997 | 17 Each       |          |       |
| D3040     |                   | Variable Air Volume Box, 1,300 Cfm                | 1997 | 4 Each        |          |       |
| D3040     |                   | Variable Air Volume Box, 800 Cfm                  | 1997 | 2 Each        |          |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component                                | Date | Quantity     | Location | Notes |
|-----------|-------------------|--|------|--------------|----------|-------|
| D3050     | FC-01, 02, 03, 04 | Fan Coil, Two-Pipe, 800 Cfm              | 1997 | 4 Each       |          |       |
| D3050     |                   | Unit Heater, 480v, 5kW                   | 1991 | 2 Each       |          |       |
| D3060     |                   | Direct Digital Controls, System Points   | 1999 | 60 Each      |          |       |
| D3060     |                   | Thermostat                               | 1999 | 25 Each      |          |       |
| D4010     |                   | Fire Alarm Control Panel                 | 1997 | 1 Each       |          |       |
| D4010     |                   | Fire Department Connection, Siamese, 3"  | 1997 | 1 Each       |          |       |
| D4010     |                   | Fire Sprinkler Head                      | 1997 | 110 Each     |          |       |
| D4010     |                   | Fire Sprinkler System                    | 1997 | 1 Each       |          |       |
| D4010     |                   | Pipe & Fittings, 1" Steel                | 1997 | 0.45 K Ln Ft |          |       |
| D4010     |                   | Pipe & Fittings, 2" Steel                | 1997 | 0.2 K Ln Ft  |          |       |
| D4010     |                   | Pipe & Fittings, 3" Steel                | 1997 | 0.1 K Ln Ft  |          |       |
| D4090     |                   | Fire Damper                              | 1997 | 16 Each      |          |       |
| D5010     |                   | Disconnect Switch, 200 Amp.              | 1991 | 1 Each       |          |       |
| D5010     |                   | Disconnect Switch, 30 Amp.               | 1991 | 16 Each      |          |       |
| D5010     |                   | Disconnect Switch, 30 Amp.               | 1997 | 4 Each       |          |       |
| D5010     |                   | Disconnect Switch, 60 Amp.               | 1991 | 4 Each       |          |       |
| D5010     |                   | Disconnect Switch, 60 Amp.               | 2004 | 1 Each       |          |       |
| D5010     |                   | Disconnect Switch, 600 Amp.              | 1992 | 1 Each       |          |       |
| D5010     |                   | Motor Starter, <5HP, <600V               | 1991 | 7 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 100 Amp. | 1996 | 10 Each      |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 100 Amp. | 1997 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 225 Amp  | 2003 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 225 Amp  | 1996 | 3 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 225 Amp  | 1995 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 400 Amp. | 1992 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 208 Y/120 V, 400 Amp. | 1996 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 480 V, 1,000 Amp.     | 1992 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 480 V, 200 Amp.       | 1992 | 2 Each       |          |       |
| D5010     |                   | Power Panel Board, 480 V, 200 Amp.       | 1996 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 480 V, 200 Amp.       | 2002 | 1 Each       |          |       |
| D5010     |                   | Power Panel Board, 480 V, 400 Amp.       | 1992 | 1 Each       |          |       |
| D5010     |                   | Secondary Transformer, Dry, 15 kVA       | 1992 | 1 Each       |          |       |
| D5010     |                   | Secondary Transformer, Dry, 150 kVA      | 1992 | 1 Each       |          |       |
| D5010     |                   | Secondary Transformer, Dry, 150 kVA      | 1996 | 1 Each       |          |       |
| D5010     |                   | Secondary Transformer, Dry, 45 kVA       | 1992 | 1 Each       |          |       |
| D5010     |                   | Secondary Transformer, Dry, 45 kVA       | 1996 | 1 Each       |          |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component   | Date | Quantity | Location | Notes |
|-----------|-------------------|---|------|----------|----------|-------|
| D5010     |                   | Variable Frequency Drive, <600 V                      | 2005 | 1 Each   |          |       |
| D5020     |                   | Compact Fluorescent Lighting Fixture, 32 w            | 1995 | 4 Each   |          |       |
| D5020     |                   | Emergency Lighting Pack, 2 Light w/ Battery           | 1960 | 6 Each   |          |       |
| D5020     |                   | Emergency Lighting Pack, 2 Light w/ Battery           | 1990 | 4 Each   |          |       |
| D5020     |                   | Emergency Lighting Pack, 2 Light w/ Battery           | 1997 | 18 Each  |          |       |
| D5020     |                   | Exit Lighting Fixture, w/ Battery                     | 1990 | 2 Each   |          |       |
| D5020     |                   | Exit Lighting Fixture, w/ Battery                     | 2000 | 1 Each   |          |       |
| D5020     |                   | Fluorescent Lighting Fixture, T12, 2-60 w             | 1990 | 48 Each  |          |       |
| D5020     |                   | Fluorescent Lighting Fixture, T12, 4-60 w             | 1991 | 149 Each |          |       |
| D5020     |                   | Halogen Lighting Fixture, 250 w                       | 1990 | 4 Each   |          |       |
| D5020     |                   | High Pressure Sodium Lighting Fixture, 250 w          | 1991 | 9 Each   |          |       |
| D5020     |                   | Incandescent Lighting Fixture, Basic, 100 w           | 1990 | 10 Each  |          |       |
| D5020     |                   | Metal Halide Lighting Fixture, High Bay, 400 w        | 1995 | 8 Each   |          |       |
| D5020     |                   | Metal Halide Lighting Fixture, Pulse Start, EP, 150 w | 1990 | 15 Each  |          |       |
| D5020     |                   | Occupancy Sensors, Indoor Lighting                    | 2006 | 2 Each   |          |       |
| D5020     |                   | Occupancy Sensors, Indoor Lighting                    | 1995 | 3 Each   |          |       |
| D5020     |                   | Receptacle, 208 V, 3 phase                            | 1991 | 4 Each   |          |       |
| D5020     |                   | Receptacle, 120 V, 20 Amp.                            | 1960 | 38 Each  |          |       |
| D5020     |                   | Receptacle, 120 V, 20 Amp.                            | 1991 | 177 Each |          |       |
| D5020     |                   | Receptacle, 120 V, 20 Amp.                            | 1997 | 36 Each  |          |       |
| D5020     |                   | Wiring Device, Switch                                 | 1960 | 15 Each  |          |       |
| D5020     |                   | Wiring Device, Switch                                 | 1991 | 45 Each  |          |       |
| D5020     |                   | Wiring Device, Switch                                 | 1997 | 10 Each  |          |       |
| D5030     |                   | Camera, Exterior, Closed Circuit, Fixed Color         | 2006 | 8 Each   |          |       |
| D5030     |                   | Card Reader   | 2006 | 2 Each   |          |       |
| D5030     |                   | Electric Lock   | 2006 | 2 Each   |          |       |
| D5030     |                   | Fire Alarm Bell, 6"                                   | 1997 | 6 Each   |          |       |
| D5030     |                   | Fire Alarm Horn & Strobe                              | 1997 | 10 Each  |          |       |
| D5030     |                   | Headend Panel, Closed Circuit                         | 2006 | 1 Each   |          |       |
| D5030     |                   | Heat Detector   | 1997 | 25 Each  |          |       |
| D5030     |                   | Intrusion Detection Motion Detector, Interior         | 2006 | 2 Each   |          |       |
| D5030     |                   | Manual Pull Station                                   | 1997 | 10 Each  |          |       |
| D5030     |                   | Monitor, Small, Closed Circuit                        | 2006 | 2 Each   |          |       |
| D5030     |                   | Oxygen Monitoring System                              | 1997 | 1 Each   |          |       |
| D5030     |                   | Public Address Speaker                                | 1960 | 1 Each   |          |       |
| D5030     |                   | Public Address Speaker                                | 1995 | 7 Each   |          |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component                                       | Date | Quantity     | Location | Notes |
|-----------|-------------------|---|------|--------------|----------|-------|
| D5030     |                   | Smoke Detector                                  | 1997 | 30 Each      |          |       |
| D5090     |                   | Grounding System                                | 1991 | 0.55 K Ln Ft |          |       |
| D5090     |                   | Grounding System                                | 1997 | 0.1 K Ln Ft  |          |       |
| G2040     |                   | Chain Link Fence Pedestrian Gate, 4' Wide       | 1991 | 1 Each       |          |       |
| G2040     |                   | Chain Link Fence Swing Gates, 8' High, 20' Opng | 1991 | 2 Each       |          |       |
| G2040     |                   | Chain Link Fence, 8'                            | 1991 | 350 Ln Ft    |          |       |

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**Average M&R Costs**

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Whitestone Research

|                         |  |                    |             |
|-------------------------|--|--------------------|-------------|
| <b>Building:</b>        | Materials Combustion Research Facility | <b>GSFT:</b>       | 15,211      |
| <b>Building Number:</b> | 1045/62/268                            | <b>PRV:</b>        | \$6,713,582 |
| <b>Facility:</b>        | Marshall Space Flight Center           | <b>Built Date:</b> | 1960        |
| <b>City:</b>            | Huntsville, AL                         |                    |             |

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**M&R Average Annual Cost Forecasts**

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|                                   | <b>Current Year</b> | <b>5 Year</b> | <b>20 Year</b> | <b>50 Year</b> |
|-----------------------------------|---------------------|---------------|----------------|----------------|
| <b>PM &amp; Minor Repair:</b>     | \$26,974            | \$26,620      | \$26,711       | \$26,401       |
| <b>Unscheduled Maintenance:</b>   | \$17,792            | \$17,890      | \$18,357       | \$18,077       |
| <b>Renewal &amp; Replacement:</b> | \$1,623             | \$35,019      | \$63,615       | \$80,598       |
| <b>Total M&amp;R Costs:</b>       | \$46,389            | \$79,529      | \$108,683      | \$125,076      |
| <b>Per GSFT:</b>                  | \$3.05              | \$5.23        | \$7.15         | \$8.22         |
| <b>As % of PRV:</b>               | 0.69%               | 1.18%         | 1.62%          | 1.86%          |

# M&R Costs by System per Year Chart

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facility

**Facility:** Marshall Space Flight Center

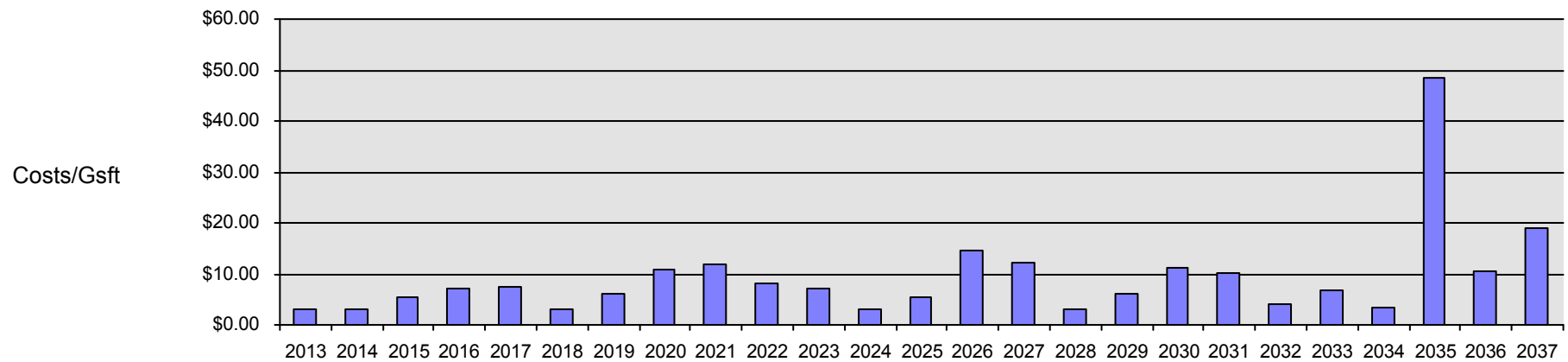
**City:** Huntsville, AL

**Building Num:** 1045/62/268

**GSFT:** 15211

Forecast Year: 2013 4 5 6 7 2018 9 0 1 2 2023 4 5 6 7 2028 9 0 1 2 2033 4 5 6 7

|   | 2013        | 4           | 5           | 6           | 7           | 2018        | 9           | 0            | 1            | 2           | 2023        | 4           | 5           | 6            | 7            | 2028        | 9           | 0            | 1            | 2           | 2033        | 4           | 5            | 6            | 7            |
|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|-------------|--------------|--------------|-------------|-------------|-------------|--------------|--------------|--------------|
| A10 Foundations                         |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| A20 Basement Construction               |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| B10 S <sub>U</sub> per Structure        |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| B20 Exterior Enclosure                  | 0.23        | 0.23        | 0.34        | 0.29        | 0.31        | 0.45        | 0.25        | 1.83         | 1.14         | 0.26        | 0.23        | 0.23        | 1.42        | 1.40         | 0.34         | 0.45        | 0.23        | 2.12         | 0.71         | 0.23        | 2.27        | 0.23        | 12.21        | 0.74         | 0.31         |
| B30 Roofing                             | 0.33        | 0.33        | 0.33        | 0.33        | 1.16        | 0.33        | 0.33        | 0.33         | 0.33         | 0.60        | 0.33        | 0.33        | 0.33        | 0.33         | 0.60         | 0.33        | 0.33        | 0.33         | 0.33         | 0.60        | 0.33        | 0.33        | 0.33         | 0.33         | 12.92        |
| C10 Interior Construction               | 0.03        | 0.17        | 0.13        | 0.09        | 0.40        | 0.00        | 0.04        | 0.23         | 0.56         | 0.06        | 0.04        | 0.01        | 0.12        | 0.09         | 0.41         | 0.01        | 0.03        | 0.23         | 0.83         | 0.07        | 0.03        | 0.17        | 0.48         | 0.09         | 1.00         |
| C20 Stairs                              |             |             | 0.01        |             |             |             | 0.01        |              | 0.01         |             | 0.01        |             |             |              | 0.01         |             |             |              | 0.01         |             |             |             | 0.01         | 0.01         |              |
| C30 Interior Finishes                   |             |             | 0.99        | 0.01        | 0.01        | 0.04        |             | 2.42         | 0.57         | 0.01        |             | 0.01        |             | 1.44         | 1.33         |             |             | 2.07         | 0.06         | 0.01        | 0.99        |             | 32.11        | 0.54         | 0.01         |
| D10 Conveying                           | 0.06        | 0.06        | 0.06        | 1.19        | 0.06        | 0.06        | 0.06        | 0.06         | 0.06         | 0.06        | 0.06        | 0.06        | 0.06        | 0.06         | 0.06         | 0.06        | 0.06        | 0.06         | 0.06         | 0.06        | 0.06        | 0.06        | 0.06         | 0.06         | 0.06         |
| D20 Plumbing                            | 0.12        | 0.05        | 0.12        | 0.58        | 0.12        | 0.06        | 0.15        | 0.06         | 0.80         | 0.56        | 0.09        | 0.06        | 0.10        | 0.42         | 0.08         | 0.12        | 0.07        | 0.12         | 0.57         | 0.08        | 0.10        | 0.12        | 0.42         | 0.43         | 0.09         |
| D30 HVAC                                | 1.19        | 1.27        | 1.60        | 1.27        | 2.28        | 1.20        | 4.18        | 3.05         | 3.69         | 1.17        | 4.45        | 1.16        | 1.20        | 1.40         | 6.38         | 1.19        | 4.20        | 2.28         | 2.69         | 1.55        | 1.29        | 1.39        | 1.25         | 4.48         | 1.30         |
| D40 Fire Protection                     | 0.26        | 0.16        | 0.26        | 0.16        | 0.57        | 0.16        | 0.26        | 0.16         | 0.27         | 0.18        | 0.26        | 0.16        | 0.26        | 0.16         | 0.78         | 0.16        | 0.26        | 0.16         | 0.26         | 0.17        | 0.27        | 0.16        | 0.26         | 0.16         | 0.57         |
| D50 Electrical                          | 0.71        | 0.67        | 1.32        | 3.01        | 2.50        | 0.75        | 0.71        | 2.51         | 2.45         | 5.19        | 1.67        | 0.76        | 1.79        | 8.87         | 2.02         | 0.67        | 0.71        | 3.66         | 4.36         | 1.33        | 1.22        | 0.67        | 1.27         | 3.21         | 2.50         |
| E10 E <sub>U</sub> equipment            |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| E20 Furnishings                         |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| F10 S <sub>U</sub> special Construction |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| F20 Selective Bldg Demolition           |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| G10 Site Preparation                    |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| G20 Site Improvements                   | 0.10        | 0.10        | 0.10        | 0.32        | 0.10        | 0.10        | 0.10        | 0.10         | 1.90         | 0.10        | 0.10        | 0.10        | 0.10        | 0.32         | 0.10         | 0.10        | 0.10        | 0.10         | 0.32         | 0.10        | 0.10        | 0.10        | 0.10         | 0.32         | 0.10         |
| G30 Site Mechanical Utilities           |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| G40 Site Electrical Utilities           |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| G90 Other Site Construction             |             |             |             |             |             |             |             |              |              |             |             |             |             |              |              |             |             |              |              |             |             |             |              |              |              |
| <b>Total</b>                            | <b>3.05</b> | <b>3.04</b> | <b>5.26</b> | <b>7.28</b> | <b>7.51</b> | <b>3.17</b> | <b>6.09</b> | <b>10.75</b> | <b>11.78</b> | <b>8.19</b> | <b>7.25</b> | <b>2.90</b> | <b>5.39</b> | <b>14.50</b> | <b>12.10</b> | <b>3.09</b> | <b>6.00</b> | <b>11.13</b> | <b>10.21</b> | <b>4.21</b> | <b>6.66</b> | <b>3.25</b> | <b>48.49</b> | <b>10.38</b> | <b>18.86</b> |



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft.

Based on a 50-Year Forecast.

Year 1-25









# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4 | 5   | 6  | 7 | 2018 | 9 | 0   | 1   | 2  | 2023 | 4 | 5   | 6  | 7   | 2028 | 9 | 0  | 1   | 2 | 2033 | 4 | 5   | 6     | 7 |  |
|--|------|---|-----|----|---|------|---|-----|-----|----|------|---|-----|----|-----|------|---|----|-----|---|------|---|-----|-------|---|--|
| Finish Repaired Steel, Painted, Exterior, 2nd Floor        |      |   |     |    |   |      |   |     |     | 24 |      |   |     |    |     |      |   |    |     |   |      |   |     |       |   |  |
| Repair Aluminum Fixed Window, 24 sf, 1st Floor             |      |   |     |    |   |      |   | 42  |     |    |      |   |     |    |     |      |   |    |     |   |      |   |     |       |   |  |
| Replace Aluminum Fixed Window, 24 sf, 1st Floor            |      |   |     |    |   |      |   |     |     |    |      |   |     |    |     |      |   |    |     |   |      |   |     | 1,214 |   |  |
| Maintain Aluminum Frame, Fully Glazed, Exterior Door Locks |      |   | 24  | 48 |   |      |   | 24  | 48  |    |      |   | 24  | 48 |     |      |   | 24 | 48  |   |      |   | 24  | 48    |   |  |
| Replace Aluminum Frame, Fully Glazed, Exterior Door Locks  |      |   | 351 |    |   |      |   |     | 702 |    |      |   | 351 |    |     |      |   |    | 702 |   |      |   | 351 |       |   |  |
| Repair Aluminum Frame, Fully Glazed, Exterior Door         |      |   | 372 |    |   |      |   | 186 |     |    |      |   |     |    | 372 |      |   |    | 186 |   |      |   |     |       |   |  |
| Replace Aluminum Frame, Fully Glazed, Exterior Door        |      |   |     |    |   |      |   |     |     |    |      |   |     |    |     |      |   |    |     |   |      |   |     |       |   |  |

## B30 Roofing

|  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|
| Repair Metal Roof                              |       |       |       |       |       | 4,110 |       |       |       | 4,110 |       |       |       |       | 4,110 |       |       |       |       | 4,110 |       |       |       |       |         |       |
| Minor Replacement, Metal Roof (2% of Roof)     |       |       |       |       |       | 3,825 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |
| Replace Metal Roof                             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 191,304 |       |
| Maintain Aluminum Gutter, Downspouts, Fittings | 299   | 299   | 299   | 299   |       | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299     | 299   |
| Maintain Metal Roof                            | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144   | 2,144 |
| Replace Aluminum Gutter, Downspouts, Fittings  |       |       |       |       |       | 5,233 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 5,233   |       |

## C10 Interior Construction

|  |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       |       |       |
|--|-----|--|-------|-----|-------|----|-----|-----|-------|-----|----|-----|-----|-----|-------|-----|-----|----|-----|-----|-----|-----|----|-------|-------|-------|
| Finish Replaced Wood, Solid Core, Painted, Interior Door       |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 75    | 149   |
| Refinish Steel, Painted, w/ Safety Glass Interior Door         |     |  | 50    | 25  |       |    | 50  | 25  |       |     | 50 | 25  |     |     | 50    | 25  |     |    | 50  | 25  |     |     | 50 |       |       |       |
| Maintain Steel, Painted, w/ Safety Glass Interior Door Locks   |     |  | 24    | 48  |       |    |     | 24  | 48    |     |    |     | 24  | 48  |       |     |     |    | 24  | 48  |     |     |    |       |       | 48    |
| Replace Steel, Painted, w/ Safety Glass Interior Door Locks    |     |  |       |     |       |    | 335 | 671 |       |     |    |     |     |     |       |     |     |    | 335 | 671 |     |     |    |       |       |       |
| Replace Steel, Painted, w/ Safety Glass Interior Door          |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 1,251 |       |
| Finish Replaced Steel, Painted, w/ Safety Glass Interior Door  |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 25    |       |
| Refinish Wood, Solid Core, Painted, Interior Door              | 149 |  | 75    | 25  | 149   |    | 75  | 25  | 149   |     | 75 | 25  | 149 |     | 75    | 25  | 149 |    |     |     | 25  | 149 |    | 75    | 25    |       |
| Maintain Wood, Solid Core, Painted, Interior Door Locks        |     |  | 24    | 71  | 143   |    |     | 24  | 71    | 143 |    |     | 24  | 71  | 143   |     |     |    | 24  | 71  | 143 |     |    | 24    | 71    |       |
| Replace Wood, Solid Core, Painted, Interior Door               |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 4,233 | 8,465 |
| Refinish Wood, Solid Core w/ Safety Glass, Painted, Interior D | 75  |  | 25    | 25  | 75    |    | 25  | 25  | 75    |     | 25 | 25  | 75  |     | 25    | 25  | 75  |    |     |     | 25  | 75  |    | 25    | 25    |       |
| Maintain Wood, Solid Core w/ Safety Glass, Painted, Interior D |     |  | 24    | 24  | 71    |    |     | 24  | 24    | 71  |    |     | 24  | 24  | 71    |     |     |    | 24  | 24  | 71  |     |    | 24    | 24    |       |
| Replace Wood, Solid Core w/ Safety Glass, Painted, Interior D  |     |  |       |     | 1,005 |    |     | 335 | 335   |     |    |     |     |     | 1,005 |     |     |    | 335 |     |     |     |    |       |       |       |
| Replace Wood, Solid Core w/ Safety Glass, Painted, Interior D  |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    | 1,410 | 4,233 |       |
| Finish Replaced Wood, Solid Core w/ Safety Glass, Painted, Int |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    | 25    | 75    |       |
| Replace Steel, Interior Door                                   |     |  |       |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 3,543 |       |
| Replace Steel, Painted, Interior Double Door w/ Safety Glass L |     |  | 335   |     |       |    |     |     | 335   |     |    |     |     | 335 |       |     |     |    |     | 335 |     |     |    | 335   |       |       |
| Replace Wood, Solid Core, Painted, Interior Door Locks         |     |  |       |     | 2,012 |    |     | 335 | 1,005 |     |    |     |     |     | 2,012 |     |     |    | 335 |     |     |     |    |       |       |       |
| Refinish Steel, Painted, Interior Door                         |     |  | 25    | 273 | 25    | 25 |     | 273 | 25    | 25  |    | 273 | 25  | 25  |       | 273 | 25  | 25 |     | 273 | 25  | 25  |    | 273   | 25    |       |
| Replace Steel, Painted, Interior Double Door Locks             |     |  |       |     | 1,341 |    |     |     |       |     |    |     |     |     | 1,341 |     |     |    |     |     |     |     |    |       |       | 1,341 |
| Replace Toilet Partitions, Painted Metal, Overhead Braced      |     |  | 2,537 |     |       |    |     |     |       |     |    |     |     |     |       |     |     |    |     |     |     |     |    |       | 2,537 |       |
| Maintain Aluminum, Fully Glazed, Interior Door Locks           |     |  | 24    | 48  |       |    |     | 24  | 48    |     |    |     | 24  | 48  |       |     |     | 24 | 48  |     |     |     | 24 | 48    |       |       |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9   | 0  | 1     | 2 | 2043 | 4 | 5 | 6     | 7  | 2048 | 9 | 0  | 1   | 2 | 2053 | 4 | 5   | 6  | 7   | 2058 | 9 | 0  | 1   | 2 |
|--|------|-----|----|-------|---|------|---|---|-------|----|------|---|----|-----|---|------|---|-----|----|-----|------|---|----|-----|---|
| Finish Repaired Steel, Painted, Exterior, 2nd Floor        |      |     |    |       |   |      |   |   |       | 24 |      |   |    |     |   |      |   |     |    |     |      |   |    |     |   |
| Repair Aluminum Fixed Window, 24 sf, 1st Floor             |      |     |    |       |   |      |   |   |       |    |      |   |    |     |   |      |   | 42  |    |     |      |   |    |     |   |
| Replace Aluminum Fixed Window, 24 sf, 1st Floor            |      |     |    |       |   |      |   |   |       |    |      |   |    |     |   |      |   |     |    |     |      |   |    |     |   |
| Maintain Aluminum Frame, Fully Glazed, Exterior Door Locks |      |     | 24 |       |   |      |   |   | 48    |    |      |   | 24 | 48  |   |      |   | 24  | 48 |     |      |   | 24 | 48  |   |
| Replace Aluminum Frame, Fully Glazed, Exterior Door Locks  |      |     |    |       |   |      |   |   |       |    |      |   |    | 702 |   |      |   | 351 |    |     |      |   |    | 702 |   |
| Repair Aluminum Frame, Fully Glazed, Exterior Door         |      | 372 |    |       |   | 186  |   |   |       |    |      |   |    |     |   | 372  |   |     |    | 186 |      |   |    |     |   |
| Replace Aluminum Frame, Fully Glazed, Exterior Door        |      |     |    | 2,670 |   |      |   |   | 1,335 |    |      |   |    |     |   |      |   |     |    |     |      |   |    |     |   |

## B30 Roofing

|  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Repair Metal Roof                              |       |       |       |       | 4,110 |       |       |       |       | 4,110 |       |       |       | 4,110 |       |       |       |       |       | 4,110 |       |       |       |       | 4,110 |
| Minor Replacement, Metal Roof (2% of Roof)     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 3,825 |       |       |       |       |       |
| Replace Metal Roof                             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Maintain Aluminum Gutter, Downspouts, Fittings | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   | 299   |       | 299   | 299   | 299   | 299   | 299   |
| Maintain Metal Roof                            | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 | 2,144 |
| Replace Aluminum Gutter, Downspouts, Fittings  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 5,233 |

## C10 Interior Construction

|   |  |     |    |     |       |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
|---|--|-----|----|-----|-------|-----|----|-----|-------|-------|----|-----|-----|-----|-------|-----|--|-----|-------|-------|--|-----|-----|-------|-------|
| Finish Replaced Wood, Solid Core, Painted, Interior Door      |  |     |    |     | 25    |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Refinish Steel, Painted, w/ Safety Glass Interior Door        |  | 75  |    |     |       | 75  |    |     |       | 75    |    |     |     | 75  |       |     |  | 75  |       |       |  | 75  |     |       |       |
| Maintain Steel, Painted, w/ Safety Glass Interior Door Locks  |  |     | 24 | 48  |       |     |    | 24  | 48    |       |    |     | 24  | 48  |       |     |  | 24  | 48    |       |  |     | 24  | 48    |       |
| Replace Steel, Painted, w/ Safety Glass Interior Door Locks   |  |     |    | 671 |       |     |    |     | 335   |       |    |     |     | 671 |       |     |  |     | 335   |       |  |     |     | 671   |       |
| Replace Steel, Painted, w/ Safety Glass Interior Door         |  |     |    |     |       |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Finish Replaced Steel, Painted, w/ Safety Glass Interior Door |  |     |    |     |       |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Refinish Wood, Solid Core, Painted, Interior Door             |  | 75  |    | 149 |       | 75  | 25 | 149 |       | 75    | 25 | 149 |     | 75  | 25    | 149 |  | 75  | 25    | 149   |  | 75  | 25  | 149   |       |
| Maintain Wood, Solid Core, Painted, Interior Door Locks       |  |     |    | 71  | 143   |     |    | 24  | 71    | 143   |    |     | 24  | 71  | 143   |     |  | 24  | 71    | 143   |  | 24  | 71  | 143   |       |
| Replace Wood, Solid Core, Painted, Interior Door              |  |     |    |     | 1,410 |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Refinish Wood, Solid Core w/ Safety Glass, Painted, Interior  |  | 25  |    | 75  |       | 25  | 25 | 75  |       | 25    | 25 | 75  |     | 25  | 25    | 75  |  | 25  | 25    | 75    |  | 25  | 25  | 75    |       |
| Maintain Wood, Solid Core w/ Safety Glass, Painted, Interior  |  |     |    | 24  | 71    |     |    | 24  | 24    | 71    |    |     | 24  | 24  | 71    |     |  | 24  | 24    | 71    |  | 24  | 24  | 71    |       |
| Replace Wood, Solid Core w/ Safety Glass, Painted, Interior   |  |     |    |     | 335   |     |    |     | 1,005 |       |    |     | 335 | 335 |       |     |  |     | 1,005 |       |  | 335 | 335 |       |       |
| Replace Wood, Solid Core w/ Safety Glass, Painted, Interior   |  |     |    |     | 1,410 |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Finish Replaced Wood, Solid Core w/ Safety Glass, Painted, I  |  |     |    |     | 25    |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Replace Steel, Interior Door                                  |  |     |    |     |       |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       |       |
| Replace Steel, Painted, Interior Double Door w/ Safety Glass  |  |     |    |     | 335   |     |    |     | 335   |       |    |     |     | 335 |       |     |  | 335 |       |       |  |     |     | 335   |       |
| Replace Wood, Solid Core, Painted, Interior Door Locks        |  |     |    |     | 1,005 |     |    |     |       | 2,012 |    |     |     | 335 | 1,005 |     |  |     |       | 2,012 |  |     | 335 | 1,005 |       |
| Refinish Steel, Painted, Interior Door                        |  | 298 |    | 25  |       | 298 |    | 25  |       | 298   |    | 25  |     | 298 |       | 25  |  | 298 |       | 25    |  | 298 |     | 25    |       |
| Replace Steel, Painted, Interior Double Door Locks            |  |     |    |     |       |     |    |     |       | 1,341 |    |     |     |     |       |     |  |     |       | 1,341 |  |     |     |       |       |
| Replace Toilet Partitions, Painted Metal, Overhead Braced     |  |     |    |     |       |     |    |     |       |       |    |     |     |     |       |     |  |     |       |       |  |     |     |       | 2,537 |
| Maintain Aluminum, Fully Glazed, Interior Door Locks          |  |     | 24 |     |       |     |    |     | 48    |       |    |     | 24  | 48  |       |     |  | 24  | 48    |       |  |     | 24  | 48    |       |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2013 | 4 | 5   | 6   | 7   | 2018 | 9   | 0     | 1     | 2  | 2023 | 4 | 5   | 6   | 7   | 2028 | 9   | 0     | 1     | 2   | 2033 | 4 | 5   | 6   | 7   |
|---|------|---|-----|-----|-----|------|-----|-------|-------|----|------|---|-----|-----|-----|------|-----|-------|-------|-----|------|---|-----|-----|-----|
| Replace Aluminum, Fully Glazed, Interior Door Locks             |      |   | 335 |     |     |      |     |       | 671   |    |      |   | 335 |     |     |      |     | 671   |       |     |      |   | 335 |     |     |
| Replace Aluminum, Fully Glazed, Interior Door                   |      |   |     |     |     |      |     |       |       |    |      |   |     |     |     |      |     |       |       |     |      |   |     |     |     |
| Maintain Steel, Interior Door Locks                             |      |   | 95  |     |     |      |     | 95    |       |    |      |   | 95  |     |     |      |     | 95    |       |     |      |   |     |     |     |
| Maintain Steel, Painted, Interior Door Locks                    |      |   | 24  | 262 | 24  |      |     | 24    | 262   | 24 |      |   | 24  | 262 | 24  |      |     | 24    | 262   | 24  |      |   |     | 262 | 24  |
| Refinish Toilet Partitions, Painted Metal, Overhead Braced      |      |   |     |     |     | 75   |     |       |       | 75 |      |   |     | 75  |     |      |     | 75    |       |     |      |   |     |     |     |
| Replace Steel, Painted, Interior Door Locks                     |      |   |     |     | 335 |      |     | 335   | 3,688 |    |      |   |     |     | 335 |      |     | 335   | 3,688 |     |      |   |     |     | 335 |
| Replace Steel, Painted, Interior Door                           |      |   |     |     |     |      |     |       |       |    |      |   |     |     |     |      |     |       |       |     |      |   |     | 886 |     |
| Finish Replaced Steel, Painted, Interior Door                   |      |   |     |     |     |      |     |       |       |    |      |   |     |     |     |      |     |       |       |     |      |   |     | 25  |     |
| Refinish Steel, Painted, Interior Double Door                   | 195  |   |     |     |     | 195  |     |       | 195   |    |      |   | 195 |     |     |      | 195 |       |       | 195 |      |   |     |     | 195 |
| Refinish Steel, Painted, Interior Double Door w/ Safety Glass   |      |   | 186 |     |     |      | 186 |       |       |    | 186  |   |     |     | 186 |      |     |       | 186   |     |      |   |     | 186 |     |
| Maintain Steel, Painted, Interior Double Door Locks             |      |   |     |     | 95  |      |     |       |       | 95 |      |   |     |     | 95  |      |     |       |       | 95  |      |   |     |     | 95  |
| Maintain Steel, Painted, Interior Double Door w/ Safety Glass L |      |   | 38  | 38  |     |      |     | 38    | 38    |    |      |   | 38  | 38  |     |      |     | 38    | 38    |     |      |   | 38  | 38  |     |
| Replace Steel, Interior Door Locks                              |      |   |     |     |     |      |     | 1,341 |       |    |      |   |     |     |     |      |     | 1,341 |       |     |      |   |     |     |     |

## C20 Stairs

|  |  |  |    |  |  |  |    |  |    |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    |    |
|--|--|--|----|--|--|--|----|--|----|--|----|--|--|--|----|--|--|--|----|--|--|--|--|----|----|
| Repair Metal, Painted, Interior Stairs           |  |  |    |  |  |  |    |  | 87 |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    | 87 |
| Finish Replaced Metal, Painted, Interior Railing |  |  |    |  |  |  |    |  |    |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    |    |
| Finish Repaired Metal, Painted, Interior Stairs  |  |  |    |  |  |  |    |  | 1  |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    | 1  |
| Refinish Metal, Painted, Interior Stairs         |  |  | 32 |  |  |  | 32 |  |    |  | 32 |  |  |  | 32 |  |  |  | 32 |  |  |  |  | 32 |    |
| Finish Repaired Metal, Painted, Interior Railing |  |  |    |  |  |  |    |  | 1  |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    | 1  |
| Repair Metal, Painted, Interior Railing          |  |  |    |  |  |  |    |  | 66 |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    | 66 |
| Refinish Metal, Painted, Interior Railing        |  |  | 45 |  |  |  | 45 |  |    |  | 45 |  |  |  | 45 |  |  |  | 45 |  |  |  |  | 45 |    |
| Replace Metal, Painted, Interior Railing         |  |  |    |  |  |  |    |  |    |  |    |  |  |  |    |  |  |  |    |  |  |  |  |    |    |

## C30 Interior Finishes

|   |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        |       |
|---|--|--|--------|--|--|-----|--|-------|--|--|-----|--|--|--------|--------|--|--|-------|--|--|--|--|--|--------|-------|
| Finish Replaced Concrete, Painted Ceiling             |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        | 3,191 |
| Repair Epoxy Flooring (2% of Floors)                  |  |  |        |  |  |     |  |       |  |  |     |  |  | 102    |        |  |  |       |  |  |  |  |  |        |       |
| Refinish Metal Decking                                |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  | 458   |  |  |  |  |  |        |       |
| Repair Metal Decking (2% of Decking)                  |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        |       |
| Replace Metal Decking                                 |  |  |        |  |  |     |  | 4,806 |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        |       |
| Repair Vinyl Tile Flooring (2% of Floors)             |  |  |        |  |  | 179 |  |       |  |  | 219 |  |  |        |        |  |  |       |  |  |  |  |  |        | 179   |
| Replace Vinyl Tile Flooring                           |  |  | 15,060 |  |  |     |  |       |  |  |     |  |  |        | 12,324 |  |  |       |  |  |  |  |  | 15,060 |       |
| Repair Acoustic Tile, Dropped Ceiling (2% of Ceiling) |  |  |        |  |  | 433 |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  | 433    |       |
| Replace Acoustical Tile, Dropped Ceiling              |  |  |        |  |  |     |  |       |  |  |     |  |  | 21,676 |        |  |  |       |  |  |  |  |  |        |       |
| Refinish Concrete, Painted Ceiling                    |  |  |        |  |  |     |  | 3,191 |  |  |     |  |  |        |        |  |  | 3,191 |  |  |  |  |  |        |       |
| Repair Concrete, Painted Ceiling (2% of Ceiling)      |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        |       |
| Finish Repaired Concrete, Painted Ceiling             |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        |       |
| Finish Replaced Metal, Painted Ceiling                |  |  |        |  |  |     |  |       |  |  |     |  |  |        |        |  |  |       |  |  |  |  |  |        | 2,479 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2038 | 9  | 0  | 1     | 2  | 2043 | 4 | 5     | 6   | 7  | 2048 | 9   | 0 | 1   | 2   | 2053  | 4 | 5     | 6   | 7   | 2058 | 9  | 0   | 1   | 2     |    |
|---|------|----|----|-------|----|------|---|-------|-----|----|------|-----|---|-----|-----|-------|---|-------|-----|-----|------|----|-----|-----|-------|----|
| Replace Aluminum, Fully Glazed, Interior Door Locks           |      |    |    |       |    |      |   |       |     |    |      |     |   | 671 |     |       |   | 335   |     |     |      |    |     |     | 671   |    |
| Replace Aluminum, Fully Glazed, Interior Door                 |      |    |    | 4,249 |    |      |   | 2,124 |     |    |      |     |   |     |     |       |   |       |     |     |      |    |     |     |       |    |
| Maintain Steel, Interior Door Locks                           |      |    | 95 |       |    |      |   | 95    |     |    |      |     |   | 95  |     |       |   | 95    |     |     |      |    |     | 95  |       |    |
| Maintain Steel, Painted, Interior Door Locks                  |      |    | 24 | 262   | 24 |      |   | 24    | 262 | 24 |      |     |   | 24  | 262 | 24    |   | 24    | 262 | 24  |      |    |     | 24  | 262   | 24 |
| Refinish Toilet Partitions, Painted Metal, Overhead Braced    | 75   |    |    |       |    | 75   |   |       |     |    |      |     |   | 75  |     |       |   |       |     |     |      | 75 |     |     |       | 75 |
| Replace Steel, Painted, Interior Door Locks                   |      |    |    | 3,688 |    |      |   |       | 335 |    |      | 335 |   |     |     | 3,688 |   |       | 335 |     | 335  |    |     |     | 3,688 |    |
| Replace Steel, Painted, Interior Door                         |      |    |    |       |    |      |   |       |     |    |      |     |   |     |     |       |   |       |     |     |      |    |     |     |       |    |
| Finish Replaced Steel, Painted, Interior Door                 |      |    |    |       |    |      |   |       |     |    |      |     |   |     |     |       |   |       |     |     |      |    |     |     |       |    |
| Refinish Steel, Painted, Interior Double Door                 |      |    |    | 195   |    |      |   | 195   |     |    |      | 195 |   |     |     | 195   |   |       |     | 195 |      |    |     | 195 |       |    |
| Refinish Steel, Painted, Interior Double Door w/ Safety Glass | 186  |    |    |       |    | 186  |   |       |     |    | 186  |     |   |     |     | 186   |   |       | 186 |     |      |    | 186 |     |       |    |
| Maintain Steel, Painted, Interior Double Door Locks           |      |    |    |       | 95 |      |   |       |     |    | 95   |     |   |     |     | 95    |   |       |     | 95  |      |    |     |     | 95    |    |
| Maintain Steel, Painted, Interior Double Door w/ Safety Glass |      | 38 | 38 |       |    |      |   | 38    | 38  |    |      |     |   | 38  | 38  |       |   |       | 38  | 38  |      |    |     | 38  | 38    |    |
| Replace Steel, Interior Door Locks                            |      |    |    |       |    |      |   | 1,341 |     |    |      |     |   |     |     |       |   | 1,341 |     |     |      |    |     |     |       |    |

## C20 Stairs

|  |  |    |  |       |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    |    |
|--|--|----|--|-------|--|----|--|----|--|--|----|--|--|----|--|----|--|--|--|----|--|--|----|----|----|
| Repair Metal, Painted, Interior Stairs           |  |    |  |       |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    | 87 |
| Finish Replaced Metal, Painted, Interior Railing |  |    |  | 45    |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    |    |
| Finish Repaired Metal, Painted, Interior Stairs  |  |    |  |       |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    | 1  |
| Refinish Metal, Painted, Interior Stairs         |  | 32 |  |       |  | 32 |  |    |  |  | 32 |  |  |    |  | 32 |  |  |  |    |  |  | 32 |    |    |
| Finish Repaired Metal, Painted, Interior Railing |  |    |  |       |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    | 1  |
| Repair Metal, Painted, Interior Railing          |  |    |  |       |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    | 66 |
| Refinish Metal, Painted, Interior Railing        |  | 45 |  |       |  |    |  | 45 |  |  |    |  |  | 45 |  | 45 |  |  |  | 45 |  |  |    | 45 |    |
| Replace Metal, Painted, Interior Railing         |  |    |  | 1,388 |  |    |  |    |  |  |    |  |  |    |  |    |  |  |  |    |  |  |    |    |    |

## C30 Interior Finishes

|   |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  |        |
|---|--|--|-----|--|-----|--|-----|--------|--|--|--|--|--|--|--|--------|--|--|--|--|-------|--|--|--|--------|
| Finish Replaced Concrete, Painted Ceiling             |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  |        |
| Repair Epoxy Flooring (2% of Floors)                  |  |  |     |  | 102 |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 102    |
| Refinish Metal Decking                                |  |  | 458 |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 458    |
| Repair Metal Decking (2% of Decking)                  |  |  | 181 |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  |        |
| Replace Metal Decking                                 |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  | 4,806  |  |  |  |  |       |  |  |  |        |
| Repair Vinyl Tile Flooring (2% of Floors)             |  |  |     |  | 219 |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 219    |
| Replace Vinyl Tile Flooring                           |  |  |     |  |     |  |     | 12,324 |  |  |  |  |  |  |  | 15,060 |  |  |  |  |       |  |  |  |        |
| Repair Acoustic Tile, Dropped Ceiling (2% of Ceiling) |  |  |     |  |     |  | 433 |        |  |  |  |  |  |  |  |        |  |  |  |  | 433   |  |  |  |        |
| Replace Acoustical Tile, Dropped Ceiling              |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 21,676 |
| Refinish Concrete, Painted Ceiling                    |  |  |     |  |     |  |     | 3,191  |  |  |  |  |  |  |  |        |  |  |  |  | 3,191 |  |  |  |        |
| Repair Concrete, Painted Ceiling (2% of Ceiling)      |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 1,125  |
| Finish Repaired Concrete, Painted Ceiling             |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  | 64     |
| Finish Replaced Metal, Painted Ceiling                |  |  |     |  |     |  |     |        |  |  |  |  |  |  |  |        |  |  |  |  |       |  |  |  |        |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2013 | 4 | 5 | 6   | 7   | 2018 | 9 | 0      | 1     | 2   | 2023 | 4 | 5   | 6 | 7     | 2028 | 9 | 0      | 1   | 2   | 2033 | 4 | 5 | 6 | 7 |         |
|---|------|---|---|-----|-----|------|---|--------|-------|-----|------|---|-----|---|-------|------|---|--------|-----|-----|------|---|---|---|---|---------|
| Finish Replaced Concrete, Painted Flooring                      |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 2,002   |
| Refinish Gypsum Board, Finished Ceiling                         |      |   |   |     |     |      |   |        | 519   |     |      |   |     |   |       |      |   |        | 519 |     |      |   |   |   |   |         |
| Repair Gypsum Board, Finished Ceiling (2% of Ceiling)           |      |   |   | 37  |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Finish Repaired Gypsum Board, Finished Ceiling                  |      |   |   | 11  |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Refinish Metal, Painted Ceiling                                 |      |   |   |     |     |      |   | 2,479  |       |     |      |   |     |   |       |      |   | 2,479  |     |     |      |   |   |   |   |         |
| Repair Metal, Painted Ceiling (2% of Ceiling)                   |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Finish Repaired Metal, Painted Ceiling                          |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Replace Metal, Painted Ceiling                                  |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 49,626  |
| Repair Concrete, Painted, Interior Wall Finish (2% of Walls)    |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Replace Concrete, Painted Ceiling                               |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 57,141  |
| Replace Concrete Block, Painted, Interior Wall Finish           |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 200,476 |
| Replace Concrete, Painted Flooring                              |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 19,020  |
| Replace Concrete, Painted, Interior Wall Finish                 |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 106,046 |
| Refinish Concrete Block, Painted, Interior Wall Finish          |      |   |   |     |     |      |   | 18,507 |       |     |      |   |     |   |       |      |   | 18,507 |     |     |      |   |   |   |   |         |
| Repair Concrete Block, Painted, Interior Wall Finish (2% of Wal |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Finish Repaired Concrete Block, Painted, Interior Wall Finish   |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Finish Replaced Concrete Block, Painted, Interior Wall Finish   |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 18,507  |
| Refinish Concrete, Painted, Interior Wall Finish                |      |   |   |     |     |      |   | 4,858  |       |     |      |   |     |   |       |      |   | 4,858  |     |     |      |   |   |   |   |         |
| Finish Repaired Concrete, Painted, Interior Wall Finish         |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 4,858   |
| Finish Replaced Concrete, Painted, Interior Wall Finish         |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Refinish Gypsum Board, Interior Wall Finish                     |      |   |   |     |     |      |   |        | 189   |     |      |   |     |   |       |      |   |        | 189 |     |      |   |   |   |   |         |
| Repair Concrete Flooring (2% of Floors)                         |      |   |   |     |     |      |   | 492    |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Repoint (50% surface) Concrete Block, Painted, Interior Wall Fi |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Repair Concrete, Painted Flooring (2% of Floors)                |      |   |   |     |     |      |   | 380    |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Repair Gypsum Board, Interior Wall Finish (2% of Walls)         |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 9       |
| Refinish Concrete, Painted Flooring                             |      |   |   |     |     |      |   | 2,002  |       |     |      |   |     |   |       |      |   | 2,002  |     |     |      |   |   |   |   |         |
| Replace Concrete Flooring                                       |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 24,626  |
| Finish Repaired Concrete, Painted Flooring                      |      |   |   |     |     |      |   | 40     |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Replace Carpet, Nylon 20 oz., Low Traffic                       |      |   |   |     |     |      |   |        | 7,971 |     |      |   |     |   | 7,811 |      |   |        |     |     |      |   |   |   |   | 7,971   |
| Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)         |      |   |   | 160 | 157 |      |   |        |       | 157 |      |   | 160 |   |       |      |   |        | 160 | 157 |      |   |   |   |   | 157     |
| Replace Plate Glass Interior Wall                               |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   |         |
| Repair Plate Glass Interior Wall                                |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 17      |
| Finish Repaired Gypsum Board, Interior Wall Finish              |      |   |   |     |     |      |   |        |       |     |      |   |     |   |       |      |   |        |     |     |      |   |   |   |   | 3       |

## D10 Conveying

|                                       |     |     |     |        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|---------------------------------------|-----|-----|-----|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Replace Hoist Electric, Chain, 3 Ton  |     |     |     | 18,098 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Maintain Hoist Electric, Chain, 3 Ton | 752 | 752 | 752 |        | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2038 | 9 | 0 | 1   | 2 | 2043 | 4 | 5      | 6 | 7 | 2048 | 9 | 0   | 1   | 2 | 2053 | 4 | 5      | 6 | 7 | 2058 | 9 | 0 | 1   | 2      |       |
|---|------|---|---|-----|---|------|---|--------|---|---|------|---|-----|-----|---|------|---|--------|---|---|------|---|---|-----|--------|-------|
| Finish Replaced Concrete, Painted Flooring                    |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Refinish Gypsum Board, Finished Ceiling                       |      |   |   | 519 |   |      |   |        |   |   |      |   | 519 |     |   |      |   |        |   |   |      |   |   | 519 |        |       |
| Repair Gypsum Board, Finished Ceiling (2% of Ceiling)         |      |   |   | 37  |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Finish Repaired Gypsum Board, Finished Ceiling                |      |   |   | 11  |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Refinish Metal, Painted Ceiling                               |      |   |   |     |   |      |   | 2,479  |   |   |      |   |     |     |   |      |   | 2,479  |   |   |      |   |   |     |        |       |
| Repair Metal, Painted Ceiling (2% of Ceiling)                 |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 985    |       |
| Finish Repaired Metal, Painted Ceiling                        |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 50     |       |
| Replace Metal, Painted Ceiling                                |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Repair Concrete, Painted, Interior Wall Finish (2% of Walls)  |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 2,087  |       |
| Replace Concrete, Painted Ceiling                             |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Replace Concrete Block, Painted, Interior Wall Finish         |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Replace Concrete, Painted Flooring                            |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Replace Concrete, Painted, Interior Wall Finish               |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Refinish Concrete Block, Painted, Interior Wall Finish        |      |   |   |     |   |      |   | 18,507 |   |   |      |   |     |     |   |      |   | 18,507 |   |   |      |   |   |     |        |       |
| Repair Concrete Block, Painted, Interior Wall Finish (2% of W |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 4,010  |       |
| Finish Repaired Concrete Block, Painted, Interior Wall Finish |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 370    |       |
| Finish Replaced Concrete Block, Painted, Interior Wall Finish |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Refinish Concrete, Painted, Interior Wall Finish              |      |   |   |     |   |      |   | 4,858  |   |   |      |   |     |     |   |      |   | 4,858  |   |   |      |   |   |     |        |       |
| Finish Repaired Concrete, Painted, Interior Wall Finish       |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 97     |       |
| Finish Replaced Concrete, Painted, Interior Wall Finish       |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Refinish Gypsum Board, Interior Wall Finish                   |      |   |   | 189 |   |      |   |        |   |   |      |   |     | 189 |   |      |   |        |   |   |      |   |   |     | 189    |       |
| Repair Concrete Flooring (2% of Floors)                       |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 492    |       |
| Repoint (50% surface) Concrete Block, Painted, Interior Wall  |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 42,368 |       |
| Repair Concrete, Painted Flooring (2% of Floors)              |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 380    |       |
| Repair Gypsum Board, Interior Wall Finish (2% of Walls)       |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 9      |       |
| Refinish Concrete, Painted Flooring                           |      |   |   |     |   |      |   | 2,002  |   |   |      |   |     |     |   |      |   | 2,002  |   |   |      |   |   |     |        |       |
| Replace Concrete Flooring                                     |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Finish Repaired Concrete, Painted Flooring                    |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 40     |       |
| Replace Carpet, Nylon 20 oz., Low Traffic                     |      |   |   |     |   |      |   | 7,811  |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 7,971  |       |
| Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)       |      |   |   | 160 |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 160    | 157   |
| Replace Plate Glass Interior Wall                             |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        | 1,049 |
| Repair Plate Glass Interior Wall                              |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     |        |       |
| Finish Repaired Gypsum Board, Interior Wall Finish            |      |   |   |     |   |      |   |        |   |   |      |   |     |     |   |      |   |        |   |   |      |   |   |     | 3      |       |

## D10 Conveying

|                                       |     |     |     |  |  |     |     |        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|---------------------------------------|-----|-----|-----|--|--|-----|-----|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Replace Hoist Electric, Chain, 3 Ton  |     |     |     |  |  |     |     | 18,098 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Maintain Hoist Electric, Chain, 3 Ton | 752 | 752 | 752 |  |  | 752 | 752 | 752    | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 | 752 |







# M&R Costs by Task

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4  | 5  | 6     | 7   | 2018 | 9   | 0  | 1     | 2 | 2023 | 4  | 5  | 6     | 7  | 2028 | 9   | 0  | 1  | 2  | 2033 | 4  | 5  | 6   | 7     |
|--|------|----|----|-------|-----|------|-----|----|-------|---|------|----|----|-------|----|------|-----|----|----|----|------|----|----|-----|-------|
| Repack Valve Glands, Emergency Eye Wash                        |      |    |    |       |     |      |     |    |       |   |      |    |    | 26    |    |      |     |    |    |    |      |    |    |     | 26    |
| Repack Valve Glands, Emergency Eye Wash & Shower Station       |      |    |    |       |     |      |     |    |       |   |      |    |    | 102   |    |      |     |    |    |    |      |    |    |     | 102   |
| Replace Emergency Eye Wash & Shower Station                    |      |    |    | 2,725 |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Emergency Eye Wash Station                             |      |    |    | 833   |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chin    | 64   | 64 |    |       | 64  |      | 64  |    | 64    |   | 64   |    | 64 |       |    | 64   |     | 64 |    | 64 |      | 64 |    | 64  | 64    |
| Replace Washer & Spud Connection, Lavatory, Vitreous China     |      |    |    |       |     | 117  |     |    |       |   |      |    |    |       |    |      |     |    |    |    | 117  |    |    |     |       |
| Replace Valve Set, Lavatory, Vitreous China                    |      |    |    |       |     |      |     |    | 397   |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 397   |
| Replace Valve Set, Sink, Stainless Steel                       |      |    |    |       |     |      |     |    | 397   |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Faucet Washer & Clean Shower Head, Ceramic Tile        | 22   |    | 22 |       |     | 22   |     | 22 |       |   | 22   |    | 22 |       | 22 |      | 22  |    | 22 |    | 22   |    | 22 |     | 22    |
| Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe)  |      |    |    | 1,418 |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Valve Set, Shower, Ceramic Tile                        |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    | 164 |       |
| Replace Shower, Ceramic Tile                                   |      |    |    |       |     |      |     |    | 1,204 |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Repair Strainer, Sink, Stainless Steel                         |      |    |    | 185   |     |      |     |    |       |   | 185  |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Sink, Stainless Steel                                  |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 3,022 |
| Replace Flush Valve, Tankless Water Closet                     |      |    |    |       |     |      |     |    | 63    |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 63    |
| Replace Tankless Water Closet                                  |      |    |    |       |     |      |     |    |       |   |      |    |    | 1,960 |    |      |     |    |    |    |      |    |    |     |       |
| Replace Flush Valve, Urinal, Vitreous China                    |      |    |    |       |     |      | 139 |    |       |   |      |    |    |       |    |      |     |    |    |    | 139  |    |    |     |       |
| Replace Urinal, Vitreous China                                 |      |    |    |       |     |      |     |    |       |   |      |    |    | 785   |    |      |     |    |    |    |      |    |    |     |       |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water       |      |    |    |       |     |      |     |    |       |   |      |    |    | 149   |    |      |     |    |    |    |      |    |    |     | 149   |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water  |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 81    |
| Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pipe) |      |    |    | 1,620 |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water        |      |    |    |       |     |      |     |    |       |   |      |    |    | 131   |    |      |     |    |    |    |      |    |    |     | 131   |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water   |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 71    |
| Replace Lavatory, Vitreous China                               |      |    |    |       |     |      |     |    |       |   |      |    |    | 1,393 |    |      |     |    |    |    |      |    |    |     |       |
| Install New Gasket & Bolts, Pipe & Fittings, 6" Cast Iron      |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Pipe & Fittings, 2" DWV PVC (20% of Pipe)              |      |    |    |       |     |      |     |    | 409   |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Check & Adjust, Air Compressor, 2 HP                           | 70   | 70 | 70 | 70    | 70  | 70   | 70  | 70 | 70    |   | 70   | 70 | 70 | 70    | 70 | 70   | 70  | 70 | 70 | 70 | 70   | 70 | 70 | 70  | 70    |
| Repair Air Compressor, 2 HP                                    | 692  |    |    |       | 692 |      |     |    | 692   |   |      |    |    | 692   |    |      | 692 |    |    |    | 692  |    |    |     | 692   |
| Replace Air Compressor, 2 HP                                   |      |    |    |       |     |      |     |    | 7,606 |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     |       |
| Replace Pipe & Fittings, 6" Cast Iron (20% of Pipe)            |      |    |    |       |     |      |     |    |       |   |      |    |    |       |    |      |     |    |    |    |      |    |    |     | 785   |

## D30 HVAC

|  |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |        |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Maintain Air Handler, Single Zone, 2,500 Cfm | 771   | 771   | 771   | 771   |       | 771   | 771   | 771   | 771 | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771    |
| Repair Exhaust Fan, Centrifugal, 800 Cfm     |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 3,485  |
| Maintain Exhaust Fan, Centrifugal, 800 Cfm   | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 |     | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680 | 1,680  |
| Replace Existing Ductwork (20% of Ductwork)  |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 482    |
| Replace Existing Ductwork (20% of Ductwork)  |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 16,820 |
| Replace Duct Insulation (20% of Insulation)  |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 6,175  |



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2013  | 4     | 5     | 6     | 7      | 2018  | 9      | 0     | 1     | 2      | 2023   | 4     | 5     | 6     | 7     | 2028  | 9      | 0     | 1     | 2     | 2033  | 4     | 5     | 6     | 7      |
|---|-------|-------|-------|-------|--------|-------|--------|-------|-------|--------|--------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|--------|
| Replace Air Handler, Single Zone, 8,000 Cfm                     |       |       |       |       |        |       |        |       |       |        | 20,560 |       |       |       |       |       |        |       |       |       |       |       |       |       | 20,560 |
| Repair Air Handler, Single Zone, 8,000 Cfm                      |       |       | 1,675 |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       | 1,675 |       |       |       |        |
| Maintain Air Handler, Single Zone, 8,000 Cfm                    | 512   | 512   | 512   | 512   | 512    | 512   | 512    | 512   | 512   | 512    |        | 512   | 512   | 512   | 512   | 512   | 512    | 512   | 512   | 512   | 512   | 512   | 512   | 512   | 512    |
| Replace Exhaust Fan, Centrifugal, 800 Cfm                       |       |       |       |       |        |       |        |       |       | 23,015 |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Repair Air Handler, Single Zone, 2,500 Cfm                      |       |       |       |       |        |       |        |       |       |        |        |       |       | 3,215 |       |       |        |       |       |       |       |       |       |       |        |
| Maintain Variable Air Volume Box, 1,300 Cfm                     | 1,521 | 1,521 | 1,521 | 1,521 | 1,521  | 1,521 | 1,521  | 1,521 | 1,521 | 1,521  |        | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521  | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521  |
| Replace Pressure Reducer Valve, 1-1/2"                          |       |       |       |       |        | 607   |        |       |       |        |        |       |       | 607   |       |       |        |       |       |       | 607   |       |       |       |        |
| Maintain Pressure Reducer Valve, 1-1/2"                         | 21    | 21    | 21    | 21    | 21     |       | 21     | 21    | 21    | 21     | 21     | 21    |       | 21    | 21    | 21    | 21     | 21    | 21    |       | 21    | 21    | 21    | 21    | 21     |
| Replace Pipe Insulation, Fiberglass, Chilled Water (20% of Ins) |       |       |       | 757   |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Replace Air Handler, Single Zone, 2,500 Cfm                     |       |       |       |       | 18,109 |       |        |       |       |        |        |       |       |       |       |       | 18,109 |       |       |       |       |       |       |       |        |
| Repair Fan Coil, Two-Pipe, 800 Cfm                              |       |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       | 1,241 |        |
| Replace Thermostat  |       |       |       |       |        |       | 9,480  |       |       |        |        |       |       |       |       |       | 9,480  |       |       |       |       |       |       |       |        |
| Replace Direct Digital Controls, System Points                  |       |       |       |       |        |       | 39,580 |       |       |        |        |       |       |       |       |       | 39,580 |       |       |       |       |       |       |       |        |
| Monitor Direct Digital Controls, System Points                  | 1,254 | 1,254 | 1,254 | 1,254 | 1,254  | 1,254 |        | 1,254 | 1,254 | 1,254  | 1,254  | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254  | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254  |
| Replace Unit Heater, 480v, 5kW                                  |       | 1,957 |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       | 1,957  |
| Repair Unit Heater, 480v, 5kW                                   |       |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       | 282    |       |       |       |       |       |       |       |        |
| Repair Variable Air Volume Box, 800 Cfm                         |       |       | 1,092 |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       | 1,092 |       |       |       |        |
| Replace Fan Coil, Two-Pipe, 800 Cfm                             |       |       |       |       |        |       |        | 7,791 |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Maintain Variable Air Volume Box, 800 Cfm                       | 730   | 730   | 730   | 730   | 730    | 730   | 730    | 730   | 730   | 730    |        | 730   | 730   | 730   | 730   | 730   | 730    | 730   | 730   | 730   | 730   | 730   | 730   | 730   | 730    |
| Maintain Fan Coil, Two-Pipe, 800 Cfm                            | 485   | 485   | 485   | 485   | 485    | 485   | 485    |       | 485   | 485    | 485    | 485   | 485   | 485   | 485   | 485   | 485    | 485   | 485   | 485   | 485   | 485   | 485   | 485   | 485    |
| Replace Variable Air Volume Box, 1,300 Cfm                      |       |       |       |       |        |       |        |       |       |        | 20,617 |       |       |       |       |       |        |       |       |       |       |       |       |       | 20,617 |
| Repair Variable Air Volume Box, 1,300 Cfm                       |       |       | 2,576 |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       | 2,576 |       |       |       |        |
| Maintain Thermostat   | 523   | 523   | 523   | 523   | 523    | 523   |        | 523   | 523   | 523    | 523    | 523   | 523   | 523   | 523   | 523   |        | 523   | 523   | 523   | 523   | 523   | 523   | 523   | 523    |
| Replace Variable Air Volume Box, 800 Cfm                        |       |       |       |       |        |       |        |       |       |        | 8,268  |       |       |       |       |       |        |       |       |       |       |       |       |       | 8,268  |
| Re-tape Pipe Insulation, Fiberglass, Chilled Water              |       |       |       |       |        |       |        |       | 249   |        |        |       |       | 249   |       |       |        |       |       | 249   |       |       |       |       | 249    |
| Maintain Unit Heater, 480v, 5kW                                 | 255   |       | 255   | 255   | 255    | 255   | 255    | 255   | 255   | 255    | 255    | 255   | 255   | 255   | 255   | 255   | 255    | 255   | 255   | 255   | 255   | 255   | 255   | 255   | 255    |
| Repair Chiller, Reciprocal Air Cooled Hermetic, 10 Ton          |       |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       | 4,373  |
| Replace Circulation Pump, 2 HP, Chiller & Condenser Water       |       |       |       |       |        |       |        |       |       | 7,929  |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Repair Circulation Pump, 5 HP, Chiller & Condenser Water        | 194   |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       | 194   |       |       |       |       | 194    |
| Maintain Circulation Pump, 5 HP, Chiller & Condenser Water      | 90    | 90    | 90    | 90    | 90     | 90    | 90     |       | 90    | 90     | 90     | 90    | 90    | 90    | 90    | 90    | 90     | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90     |
| Replace Chiller, Reciprocal Air Cooled Hermetic, 60 Ton         |       |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       | 81,698 |
| Repair Chiller, Reciprocal Air Cooled Hermetic, 60 Ton          |       |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Replace Circulation Pump, 5 HP, Chiller & Condenser Water       |       |       |       |       |        |       |        |       |       | 7,929  |        |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Replace Chiller, Reciprocal Air Cooled Hermetic, 10 Ton         |       |       |       |       |        |       |        |       |       |        | 13,248 |       |       |       |       |       |        |       |       |       |       |       |       |       |        |
| Repair Circulation Pump, 2 HP, Chiller & Condenser Water        | 194   |       |       |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       | 194   |       |       |       |       | 194    |
| Maintain Chiller, Reciprocal Air Cooled Hermetic, 10 Ton        | 921   | 921   | 921   | 921   | 921    | 921   | 921    | 921   |       | 921    | 921    | 921   | 921   | 921   | 921   | 921   | 921    | 921   | 921   | 921   | 921   | 921   | 921   | 921   | 921    |
| Replace Air Separator, 2"                                       |       |       | 1,286 |       |        |       |        |       |       |        |        |       |       |       |       |       |        |       |       |       | 1,286 |       |       |       |        |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2038  | 9      | 0     | 1     | 2     | 2043  | 4     | 5      | 6      | 7     | 2048  | 9      | 0     | 1     | 2      | 2053  | 4     | 5     | 6     | 7     | 2058   | 9     | 0     | 1     | 2      |
|---|-------|--------|-------|-------|-------|-------|-------|--------|--------|-------|-------|--------|-------|-------|--------|-------|-------|-------|-------|-------|--------|-------|-------|-------|--------|
| Replace Air Handler, Single Zone, 8,000 Cfm                   |       |        |       |       |       |       |       |        |        |       |       | 20,560 |       |       |        |       |       |       |       |       |        |       |       |       | 20,560 |
| Repair Air Handler, Single Zone, 8,000 Cfm                    |       |        |       |       |       |       |       | 1,675  |        |       |       |        |       |       |        |       |       |       |       |       | 1,675  |       |       |       |        |
| Maintain Air Handler, Single Zone, 8,000 Cfm                  | 512   | 512    | 512   | 512   | 512   | 512   | 512   | 512    | 512    | 512   | 512   |        | 512   | 512   | 512    | 512   | 512   | 512   | 512   | 512   | 512    | 512   | 512   | 512   | 512    |
| Replace Exhaust Fan, Centrifugal, 800 Cfm                     |       |        |       |       |       |       |       | 23,015 |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       |        |
| Repair Air Handler, Single Zone, 2,500 Cfm                    |       | 3,215  |       |       |       |       |       |        |        |       |       |        |       |       | 3,215  |       |       |       |       |       |        |       |       |       |        |
| Maintain Variable Air Volume Box, 1,300 Cfm                   | 1,521 | 1,521  | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521  | 1,521  | 1,521 | 1,521 |        | 1,521 | 1,521 | 1,521  | 1,521 | 1,521 | 1,521 | 1,521 | 1,521 | 1,521  | 1,521 | 1,521 | 1,521 | 1,521  |
| Replace Pressure Reducer Valve, 1-1/2"                        |       | 607    |       |       |       |       |       |        | 607    |       |       |        |       |       |        | 607   |       |       |       |       |        |       |       |       | 607    |
| Maintain Pressure Reducer Valve, 1-1/2"                       | 21    |        | 21    | 21    | 21    | 21    | 21    | 21     |        | 21    | 21    | 21     | 21    | 21    | 21     |       | 21    | 21    | 21    | 21    | 21     | 21    | 21    | 21    | 21     |
| Replace Pipe Insulation, Fiberglass, Chilled Water (20% of In |       |        |       | 757   |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       |        |
| Replace Air Handler, Single Zone, 2,500 Cfm                   |       |        |       |       |       |       |       |        | 18,109 |       |       |        |       |       |        |       |       |       |       |       | 18,109 |       |       |       |        |
| Repair Fan Coil, Two-Pipe, 800 Cfm                            |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 1,241  |
| Replace Thermostat  |       | 9,480  |       |       |       |       |       |        |        |       |       |        |       |       | 9,480  |       |       |       |       |       |        |       |       |       | 9,480  |
| Replace Direct Digital Controls, System Points                |       | 39,580 |       |       |       |       |       |        |        |       |       |        |       |       | 39,580 |       |       |       |       |       |        |       |       |       | 39,580 |
| Monitor Direct Digital Controls, System Points                | 1,254 |        | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254  | 1,254  | 1,254 | 1,254 |        | 1,254 | 1,254 | 1,254  | 1,254 | 1,254 | 1,254 | 1,254 | 1,254 | 1,254  | 1,254 | 1,254 | 1,254 | 1,254  |
| Replace Unit Heater, 480v, 5kW                                |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 1,957  |
| Repair Unit Heater, 480v, 5kW                                 |       |        |       |       |       |       |       |        |        |       |       |        |       |       | 282    |       |       |       |       |       |        |       |       |       |        |
| Repair Variable Air Volume Box, 800 Cfm                       |       |        |       |       |       |       |       |        | 1,092  |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 1,092  |
| Replace Fan Coil, Two-Pipe, 800 Cfm                           |       |        |       |       |       |       |       | 7,791  |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       |        |
| Maintain Variable Air Volume Box, 800 Cfm                     | 730   | 730    | 730   | 730   | 730   | 730   | 730   | 730    | 730    | 730   | 730   |        | 730   | 730   | 730    | 730   | 730   | 730   | 730   | 730   | 730    | 730   | 730   | 730   | 730    |
| Maintain Fan Coil, Two-Pipe, 800 Cfm                          | 485   | 485    | 485   | 485   | 485   |       | 485   | 485    | 485    | 485   | 485   | 485    | 485   | 485   | 485    | 485   | 485   | 485   | 485   | 485   | 485    | 485   | 485   | 485   | 485    |
| Replace Variable Air Volume Box, 1,300 Cfm                    |       |        |       |       |       |       |       |        |        |       |       |        |       |       | 20,617 |       |       |       |       |       |        |       |       |       | 20,617 |
| Repair Variable Air Volume Box, 1,300 Cfm                     |       |        |       |       |       |       |       |        |        |       |       |        |       |       | 2,576  |       |       |       |       |       |        |       |       |       | 2,576  |
| Maintain Thermostat   | 523   |        | 523   | 523   | 523   | 523   | 523   | 523    | 523    | 523   | 523   |        | 523   | 523   | 523    | 523   | 523   | 523   | 523   | 523   | 523    | 523   | 523   | 523   | 523    |
| Replace Variable Air Volume Box, 800 Cfm                      |       |        |       |       |       |       |       |        |        |       |       |        |       |       | 8,268  |       |       |       |       |       |        |       |       |       | 8,268  |
| Re-tape Pipe Insulation, Fiberglass, Chilled Water            |       |        |       |       |       |       |       |        | 249    |       |       |        |       | 249   |        |       |       |       | 249   |       |        |       |       |       | 249    |
| Maintain Unit Heater, 480v, 5kW                               | 255   | 255    | 255   | 255   | 255   | 255   | 255   | 255    | 255    | 255   | 255   | 255    | 255   | 255   | 255    | 255   | 255   | 255   | 255   | 255   | 255    | 255   | 255   | 255   | 255    |
| Repair Chiller, Reciprocal Air Cooled Hermetic, 10 Ton        |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       |        |
| Replace Circulation Pump, 2 HP, Chiller & Condenser Water     |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 7,929  |
| Repair Circulation Pump, 5 HP, Chiller & Condenser Water      |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 194    |
| Maintain Circulation Pump, 5 HP, Chiller & Condenser Water    | 90    | 90     | 90    | 90    | 90    |       | 90    | 90     | 90     | 90    | 90    | 90     | 90    | 90    | 90     | 90    | 90    | 90    | 90    | 90    | 90     | 90    | 90    | 90    | 90     |
| Replace Chiller, Reciprocal Air Cooled Hermetic, 60 Ton       |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 81,698 |
| Repair Chiller, Reciprocal Air Cooled Hermetic, 60 Ton        |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 29,016 |
| Replace Circulation Pump, 5 HP, Chiller & Condenser Water     |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 7,929  |
| Replace Chiller, Reciprocal Air Cooled Hermetic, 10 Ton       |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 13,248 |
| Repair Circulation Pump, 2 HP, Chiller & Condenser Water      |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 194    |
| Maintain Chiller, Reciprocal Air Cooled Hermetic, 10 Ton      | 921   | 921    | 921   | 921   | 921   | 921   | 921   | 921    | 921    | 921   | 921   | 921    | 921   | 921   |        | 921   | 921   | 921   | 921   | 921   | 921    | 921   | 921   | 921   | 921    |
| Replace Air Separator, 2"                                     |       |        |       |       |       |       |       |        |        |       |       |        |       |       |        |       |       |       |       |       |        |       |       |       | 1,286  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013  | 4     | 5     | 6     | 7     | 2018  | 9     | 0     | 1     | 2     | 2023  | 4     | 5     | 6     | 7   | 2028  | 9     | 0     | 1     | 2     | 2033  | 4     | 5     | 6     | 7     |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Maintain Air Separator, 2"                                 | 64    | 64    |       | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64  | 64    | 64    | 64    | 64    | 64    |       | 64    | 64    | 64    | 64    |
| Repack Gland, Gate Valve, 2-3"                             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       | 572   |       |       |       |       |
| Replace Gate Valve, 2-3"                                   |       |       |       |       |       |       |       |       | 5,841 |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 3" Steel      |       |       |       |       |       |       |       |       |       | 41    |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Maintain Chiller, Reciprocal Air Cooled Hermetic, 60 Ton   | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 |     | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 |
| Replace Pipe & Fittings, 1" Copper (20% of Pipe)           |       |       |       | 810   |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace 10' Section, Pipe & Fittings, 3" Steel             |       |       |       |       |       |       |       |       | 102   |       |       |       |       |       |     |       |       |       |       |       | 102   |       |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel      |       |       |       | 25    |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace 10' Section, Pipe & Fittings, 2" Steel             |       |       | 45    |       |       |       |       |       |       |       |       |       |       | 45    |     |       |       |       |       |       |       |       |       |       |       |
| Maintain Circulation Pump, 2 HP, Chiller & Condenser Water | 90    | 90    | 90    | 90    | 90    | 90    | 90    |       | 90    | 90    | 90    | 90    | 90    | 90    | 90  | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    |
| Replace 10' Section, Pipe & Fittings, 1" Steel             |       |       |       | 51    |       |       |       |       |       |       |       |       |       |       | 51  |       |       |       |       |       |       |       |       |       |       |
| Maintain Expansion Tank, 30 Gal.                           | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21  | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |
| Replace 10' Section, Pipe & Fittings, 1" Copper            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       | 41    |       |
| Resolder Joint, Pipe & Fittings, 1" Copper                 |       |       |       |       |       |       |       |       |       |       |       |       |       | 66    |     |       |       |       |       |       |       |       |       | 66    |       |
| Maintain Flow Control Valve & Actuator, 1"                 | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   |       | 669   | 669   | 669   | 669 | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel      |       |       |       | 39    |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace Expansion Tank, 30 Gal.                            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace Flow Control Valve, Motorized, 2"                  |       |       |       |       |       |       |       |       |       |       | 1,679 |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace Valve Actuator, 1"                                 |       |       |       |       |       |       |       | 4,719 |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Replace Flow Control Valve, Motorized, 1"                  |       |       |       |       |       |       |       |       |       |       | 4,202 |       |       |       |     |       |       |       |       |       |       |       |       |       |       |
| Maintain Flow Control Valve & Actuator, 2"                 | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       | 83    | 83    | 83    | 83  | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |
| Replace Valve Actuator, 2"                                 |       |       |       |       |       |       |       | 1,132 |       |       |       |       |       |       |     |       |       |       |       |       |       |       |       |       |       |

## D40 Fire Protection

|   |       |     |       |     |       |     |       |     |       |     |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
|---|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-------|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|
| Replace Fire Alarm Control Panel                      |       |     |       |     |       |     |       |     |       |     |       |     |       |       |       |     |       |     |       |     |       |     |       |     | 3,219 |
| Replace 10' Section, Pipe & Fittings, 1" Steel        |       |     |       |     |       |     |       |     | 65    |     |       |     |       |       |       |     |       |     |       |     | 65    |     |       |     |       |
| Inspect & Test Fire Damper                            | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |       | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |     | 1,155 |
| Install New Gasket & Bolts, Pipe & Fittings, 3" Steel |       |     |       |     |       |     |       |     |       | 13  |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
| Replace 10' Section, Pipe & Fittings, 3" Steel        |       |     |       |     |       |     |       |     |       | 31  |       |     |       |       |       |     |       |     |       |     | 31    |     |       |     |       |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel |       |     |       |     |       |     |       |     |       | 23  |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
| Replace 10' Section, Pipe & Fittings, 2" Steel        |       |     |       |     |       |     |       |     |       | 40  |       |     |       |       |       |     |       |     |       |     | 40    |     |       |     |       |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel |       |     |       |     |       |     |       |     |       | 51  |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
| Replace Fire Department Connection, Siamese, 3"       |       |     |       |     |       |     |       |     |       |     |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
| Maintain Fire Sprinkler System                        | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821   | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821 | 821   | 821 | 821   |
| Replace Fire Sprinkler Head                           |       |     |       |     |       |     |       |     |       |     |       |     |       |       |       |     |       |     |       |     |       |     |       |     |       |
| Inspect Fire Sprinkler Head                           | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69    | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69  | 69    | 69  | 69    |
| Replace Fire Damper                                   |       |     |       |     |       |     |       |     |       |     |       |     |       | 1,684 |       |     |       |     |       |     |       |     |       |     |       |
| Repair Fire Alarm Control Panel                       |       |     |       |     | 122   |     |       |     |       |     | 122   |     |       |       |       |     |       |     |       |     | 122   |     |       |     | 122   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2038  | 9     | 0     | 1     | 2     | 2043  | 4     | 5     | 6     | 7     | 2048  | 9     | 0     | 1     | 2     | 2053  | 4     | 5     | 6     | 7     | 2058  | 9     | 0     | 1     | 2     |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Maintain Air Separator, 2"                                 | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    |       |       | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    | 64    |       |
| Repack Gland, Gate Valve, 2-3"                             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 572   |
| Replace Gate Valve, 2-3"                                   |       |       |       |       |       |       |       |       | 5,841 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 3" Steel      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 41    |
| Maintain Chiller, Reciprocal Air Cooled Hermetic, 60 Ton   | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 | 1,457 |
| Replace Pipe & Fittings, 1" Copper (20% of Pipe)           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 810   |
| Replace 10' Section, Pipe & Fittings, 3" Steel             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 102   |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 25    |
| Replace 10' Section, Pipe & Fittings, 2" Steel             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 45    |
| Maintain Circulation Pump, 2 HP, Chiller & Condenser Water | 90    | 90    | 90    | 90    | 90    |       | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    |
| Replace 10' Section, Pipe & Fittings, 1" Steel             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 51    |
| Maintain Expansion Tank, 30 Gal.                           | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |       | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    |
| Replace 10' Section, Pipe & Fittings, 1" Copper            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 41    |
| Resolder Joint, Pipe & Fittings, 1" Copper                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 66    |
| Maintain Flow Control Valve & Actuator, 1"                 | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   |       | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   | 669   |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 39    |
| Replace Expansion Tank, 30 Gal.                            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 1,823 |
| Replace Flow Control Valve, Motorized, 2"                  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 1,679 |
| Replace Valve Actuator, 1"                                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 4,719 |
| Replace Flow Control Valve, Motorized, 1"                  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 4,202 |
| Maintain Flow Control Valve & Actuator, 2"                 | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |       | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    | 83    |
| Replace Valve Actuator, 2"                                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 1,132 |

## D40 Fire Protection

|   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| Replace Fire Alarm Control Panel                      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3,219 |
| Replace 10' Section, Pipe & Fittings, 1" Steel        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 65    |
| Inspect & Test Fire Damper                            |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1,155 |
| Install New Gasket & Bolts, Pipe & Fittings, 3" Steel |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 13    |
| Replace 10' Section, Pipe & Fittings, 3" Steel        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 31    |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 23    |
| Replace 10' Section, Pipe & Fittings, 2" Steel        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 40    |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 51    |
| Replace Fire Department Connection, Siamese, 3"       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1,210 |
| Maintain Fire Sprinkler System                        | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821 | 821   |
| Replace Fire Sprinkler Head                           |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 7,570 |
| Inspect Fire Sprinkler Head                           | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  |     | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69  | 69    |
| Replace Fire Damper                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 1,684 |
| Repair Fire Alarm Control Panel                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 122   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4   | 5   | 6     | 7   | 2018 | 9   | 0   | 1   | 2   | 2023 | 4   | 5   | 6     | 7   | 2028 | 9   | 0   | 1   | 2   | 2033 | 4   | 5   | 6   | 7     |
|--|------|-----|-----|-------|-----|------|-----|-----|-----|-----|------|-----|-----|-------|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-------|
| Inspect & Test Fire Alarm Control Panel                    | 131  | 131 | 131 | 131   | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131   | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 | 131   |
| Inspect & Maintain Fire Department Connection, Siamese, 3" | 123  | 123 | 123 | 123   | 123 | 123  | 123 | 123 | 123 | 123 | 123  | 123 | 123 | 123   | 123 | 123  | 123 | 123 | 123 | 123 | 123  | 123 | 123 | 123 | 123   |
| Test Fire Sprinkler Head                                   |      |     |     | 3,469 |     |      |     |     |     |     |      |     |     | 3,469 |     |      |     |     |     |     |      |     |     |     | 3,469 |
| Test Gages & Valves, Fire Sprinkler System                 | 757  | 757 | 757 | 757   | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757   | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757   |

## D50 Electrical

|   |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
|---|-----|-----|-------|-------|-------|-----|-----|-------|--------|-----|-----|-----|-------|-----|-----|-----|-----|--------|--------|--------|-----|-------|-------|-------|
| Replace Batteries & Check Operation, Oxygen Monitoring Syst     | 18  | 18  | 18    | 18    | 18    | 18  | 18  | 18    | 18     | 18  | 18  | 18  | 18    | 18  | 18  | 18  | 18  | 18     | 18     | 18     | 18  | 18    | 18    | 18    |
| Replace Metal Halide Lighting Fixture, Pulse Start, EP, 150 w   |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        |        | 23,341 |     |       |       |       |
| Inspect & Maintain Occupancy Sensor, Indoor Lighting            | 162 | 162 | 162   | 162   | 162   | 162 | 162 | 162   | 97     | 162 | 162 | 162 | 65    | 162 | 162 | 162 | 162 | 162    | 162    | 162    | 162 | 162   | 162   | 162   |
| Replace Control Unit, Occupancy Sensors, Indoor Lighting        |     |     | 328   | 219   |       |     |     | 328   |        |     |     |     |       | 219 |     |     |     | 328    | 219    |        |     |       | 328   |       |
| Replace Occupancy Sensors, Indoor Lighting                      |     |     |       |       |       |     |     | 1,913 |        |     |     |     | 2,870 |     |     |     |     |        |        |        |     |       |       | 1,913 |
| Replace Receptacle, 120 V, 20 Amp.                              |     |     |       | 2,993 |       |     |     | 3,159 |        |     |     |     |       |     |     |     |     | 14,712 |        |        |     |       |       | 2,993 |
| Replace Receptacle, 208 V, 3 phase                              |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     | 484    |        |        |     |       |       |       |
| Replace Metal Halide Lighting Fixture, Pulse Start, EP, 150 w   |     |     |       |       |       |     |     | 7,431 |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Wiring Device, Switch                                   |     |     |       |       |       |     |     | 529   | 1,589  |     |     |     |       |     |     |     |     | 353    |        |        |     |       | 529   | 1,589 |
| Replace Incandescent Lighting Fixture, Basic, 100 w             |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        | 1,455  |        |     |       |       |       |
| Repair Oxygen Monitoring System                                 |     |     |       |       | 42    |     |     |       |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       | 42    |
| Repair Wiring Device, Switch                                    |     |     |       | 336   |       |     |     |       |        |     |     |     |       |     |     |     |     |        |        |        | 503 | 1,510 |       | 336   |
| Replace Lamp, Metal Halide Lighting Fixture, Pulse Start, EP, 1 |     |     | 643   |       |       |     |     | 643   |        |     |     |     | 643   |     |     |     |     |        |        |        |     |       | 643   |       |
| Replace Metal Halide Lighting Fixture, High Bay, 400 w          |     |     | 5,524 |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        |        |        |     |       | 5,524 |       |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T12, 4-  |     |     |       |       |       |     |     |       | 15,619 |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Lamp, Metal Halide Lighting Fixture, High Bay, 400 w    |     |     |       |       |       |     |     | 1,064 |        |     |     |     | 1,064 |     |     |     |     | 1,064  |        |        |     |       |       |       |
| Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w       |     |     | 96    |       |       |     |     | 96    |        |     |     |     | 96    |     |     |     |     |        |        |        |     |       | 96    |       |
| Replace HP Sodium Lighting Fixture, 250 w                       |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        | 9,594  |        |     |       |       |       |
| Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w       |     |     |       |       |       |     |     | 3,386 |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Halogen Lighting Fixture, 250 w                         |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        | 3,953  |        |     |       |       |       |
| Replace Ballast & Lamp, Halogen Lighting Fixture, 250 w         |     |     |       |       |       |     |     | 2,241 |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Fluorescent Lighting Fixture, T12, 2-60 w               |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        | 8,508  |        |     |       |       |       |
| Replace Fluorescent Lighting Fixture, T12, 4-60 w               |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     |        | 26,411 |        |     |       |       |       |
| Replace Oxygen Monitoring System                                |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     | 3,647  |        |        |     |       |       |       |
| Replace Ballast, Metal Halide Lighting Fixture, High Bay, 400 w |     |     |       |       |       |     |     |       |        |     |     |     | 2,679 |     |     |     |     |        |        |        |     |       |       |       |
| Maintain Intrusion Detection Motion Detector, Interior          | 62  | 62  | 62    |       | 62    | 62  | 62  | 62    | 62     | 62  | 62  | 62  | 62    | 62  | 62  | 62  | 62  | 62     | 62     | 62     | 62  | 62    | 62    | 62    |
| Repair Disconnect Switch, 600 Amp.                              |     |     |       |       |       |     |     |       |        | 234 |     |     |       |     |     |     |     |        | 234    |        |     |       |       |       |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T12, 2-  |     |     |       |       |       |     |     | 5,032 |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Lightning Protection General Wiring                     |     |     |       | 1,658 |       |     |     |       |        | 301 |     |     |       |     |     |     |     |        |        |        |     |       |       |       |
| Replace Smoke Detector  |     |     |       |       |       |     |     |       |        |     |     |     |       |     |     |     |     | 4,709  |        |        |     |       |       |       |
| Repair Smoke Detector   |     |     |       |       | 1,269 |     |     |       |        |     |     |     |       |     |     |     |     |        |        |        |     |       |       | 1,269 |
| Replace Batteries & Check Operation, Smoke Detector             | 576 | 576 | 576   | 576   | 576   | 576 | 576 | 576   | 576    | 576 | 576 | 576 | 576   | 576 | 576 | 576 | 576 | 576    | 576    | 576    | 576 | 576   | 576   | 576   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9   | 0   | 1   | 2   | 2043 | 4   | 5   | 6   | 7   | 2048 | 9   | 0   | 1   | 2   | 2053 | 4   | 5   | 6   | 7     | 2058 | 9   | 0   | 1   | 2   |
|--|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-------|------|-----|-----|-----|-----|
| Inspect & Test Fire Alarm Control Panel                    | 131  | 131 | 131 | 131 |     | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 |       | 131  | 131 | 131 | 131 | 131 |
| Inspect & Maintain Fire Department Connection, Siamese, 3" | 123  | 123 | 123 | 123 | 123 | 123  | 123 | 123 | 123 |     | 123  | 123 | 123 | 123 | 123 | 123  | 123 | 123 | 123 | 123   | 123  | 123 | 123 | 123 | 123 |
| Test Fire Sprinkler Head                                   |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |     |     |     | 3,469 |      |     |     |     |     |
| Test Gages & Valves, Fire Sprinkler System                 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757   | 757  | 757 | 757 | 757 | 757 |

## D50 Electrical

|   |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       |       |        |     |     |
|---|-----|-------|-------|--------|-------|-----|-----|-------|-------|-----|-----|-----|-----|--------|-------|--------|-------|-----|-------|--------|-------|-------|--------|-----|-----|
| Replace Batteries & Check Operation, Oxygen Monitoring Sys    | 18  | 18    | 18    | 18     |       | 18  | 18  | 18    | 18    | 18  | 18  | 18  | 18  | 18     | 18    | 18     | 18    | 18  | 18    |        | 18    | 18    | 18     | 18  | 18  |
| Replace Metal Halide Lighting Fixture, Pulse Start, EP, 150 w |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       | 23,341 |       |       |        |     |     |
| Inspect & Maintain Occupancy Sensor, Indoor Lighting          | 162 | 162   | 65    | 162    | 162   | 162 | 162 | 162   | 162   | 162 | 162 | 162 | 162 | 97     | 162   | 162    | 162   | 65  | 162   | 162    | 162   | 162   | 162    | 162 | 162 |
| Replace Control Unit, Occupancy Sensors, Indoor Lighting      |     |       |       | 219    |       |     |     | 328   | 219   |     |     |     | 328 |        |       |        |       |     | 219   |        |       | 328   | 219    |     |     |
| Replace Occupancy Sensors, Indoor Lighting                    |     | 2,870 |       |        |       |     |     |       |       |     |     |     |     | 1,913  |       |        | 2,870 |     |       |        |       |       |        |     |     |
| Replace Receptacle, 120 V, 20 Amp.                            |     | 3,159 |       |        |       |     |     |       |       |     |     |     |     | 14,712 |       |        |       |     | 2,993 |        |       | 3,159 |        |     |     |
| Replace Receptacle, 208 V, 3 phase                            |     |       |       |        |       |     |     |       |       |     |     |     |     | 484    |       |        |       |     |       |        |       |       |        |     |     |
| Replace Metal Halide Lighting Fixture, Pulse Start, EP, 150 w |     | 7,431 |       |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       | 7,431 |        |     |     |
| Replace Wiring Device, Switch                                 |     |       |       |        | 353   |     |     |       |       |     |     |     |     | 529    | 1,589 |        |       |     |       | 353    |       |       |        |     |     |
| Replace Incandescent Lighting Fixture, Basic, 100 w           |     |       |       |        |       |     |     |       |       |     |     |     |     | 1,455  |       |        |       |     |       |        |       |       |        |     |     |
| Repair Oxygen Monitoring System                               |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 42     |       |     |       |        |       |       |        |     |     |
| Repair Wiring Device, Switch                                  |     |       |       |        |       |     |     | 503   | 1,510 |     |     |     |     |        | 336   |        |       |     |       |        |       | 503   | 1,510  |     |     |
| Replace Lamp, Metal Halide Lighting Fixture, Pulse Start, EP, |     | 643   |       |        |       |     |     | 643   |       |     |     |     |     |        |       |        |       | 643 |       |        |       | 643   |        |     |     |
| Replace Metal Halide Lighting Fixture, High Bay, 400 w        |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       |        | 5,524 |     |       |        |       |       |        |     |     |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T12, 4 |     |       |       | 15,619 |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       |       | 15,619 |     |     |
| Replace Lamp, Metal Halide Lighting Fixture, High Bay, 400 w  |     |       | 1,064 |        |       |     |     | 1,064 |       |     |     |     |     | 1,064  |       |        |       |     |       |        |       | 1,064 |        |     |     |
| Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w     |     |       | 96    |        |       |     |     | 96    |       |     |     |     |     |        |       |        |       | 96  |       |        |       | 96    |        |     |     |
| Replace HP Sodium Lighting Fixture, 250 w                     |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 9,594  |       |     |       |        |       |       |        |     |     |
| Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w     |     |       |       | 3,386  |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       |       | 3,386  |     |     |
| Replace Halogen Lighting Fixture, 250 w                       |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 3,953  |       |     |       |        |       |       |        |     |     |
| Replace Ballast & Lamp, Halogen Lighting Fixture, 250 w       |     | 2,241 |       |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       |       | 2,241  |     |     |
| Replace Fluorescent Lighting Fixture, T12, 2-60 w             |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 8,508  |       |     |       |        |       |       |        |     |     |
| Replace Fluorescent Lighting Fixture, T12, 4-60 w             |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 26,411 |       |     |       |        |       |       |        |     |     |
| Replace Oxygen Monitoring System                              |     |       |       |        | 3,647 |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        | 3,647 |       |        |     |     |
| Replace Ballast, Metal Halide Lighting Fixture, High Bay, 400 |     |       |       |        |       |     |     | 2,679 |       |     |     |     |     |        |       |        |       |     |       |        |       |       |        |     |     |
| Maintain Intrusion Detection Motion Detector, Interior        | 62  | 62    | 62    | 62     | 62    | 62  | 62  | 62    |       | 62  | 62  | 62  | 62  | 62     | 62    | 62     | 62    | 62  | 62    |        | 62    | 62    | 62     | 62  | 62  |
| Repair Disconnect Switch, 600 Amp.                            |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       | 234    |       |       |        |     | 234 |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T12, 2 |     |       | 5,032 |        |       |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        |       | 5,032 |        |     |     |
| Replace Lightning Protection General Wiring                   |     |       |       | 1,658  |       |     |     |       |       | 301 |     |     |     |        |       |        |       |     |       |        |       |       |        |     |     |
| Replace Smoke Detector  |     |       |       |        | 4,709 |     |     |       |       |     |     |     |     |        |       |        |       |     |       |        | 4,709 |       |        |     |     |
| Repair Smoke Detector   |     |       |       |        |       |     |     |       |       |     |     |     |     |        |       | 1,269  |       |     |       |        |       |       |        |     |     |
| Replace Batteries & Check Operation, Smoke Detector           | 576 | 576   | 576   | 576    |       | 576 | 576 | 576   | 576   | 576 | 576 | 576 | 576 | 576    | 576   | 576    | 576   | 576 | 576   |        | 576   | 576   | 576    | 576 | 576 |



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4   | 5     | 6      | 7     | 2018  | 9   | 0   | 1     | 2     | 2023 | 4   | 5     | 6      | 7     | 2028 | 9   | 0     | 1   | 2   | 2033  | 4   | 5   | 6     | 7      |     |
|--|------|-----|-------|--------|-------|-------|-----|-----|-------|-------|------|-----|-------|--------|-------|------|-----|-------|-----|-----|-------|-----|-----|-------|--------|-----|
| Replace Public Address Speaker                         |      |     |       |        |       |       |     | 293 |       |       |      |     | 2,049 |        |       |      |     |       |     |     |       |     |     | 293   |        |     |
| Maintain Public Address Speaker                        | 162  | 162 | 162   | 162    | 162   | 162   | 162 | 141 | 162   | 162   | 162  | 162 | 21    | 162    | 162   | 162  | 162 | 162   | 162 | 162 | 162   | 162 | 162 | 141   | 162    | 162 |
| Replace Monitor, Small, Closed Circuit                 |      |     |       | 3,504  |       |       |     |     |       |       |      |     |       | 3,504  |       |      |     |       |     |     |       |     |     | 3,504 |        |     |
| Replace Manual Pull Station                            |      |     |       |        |       |       |     |     |       |       |      |     |       |        | 1,212 |      |     |       |     |     |       |     |     |       |        |     |
| Check & Repair Manual Pull Station                     |      |     |       |        | 525   |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       | 525    |     |
| Maintain & Repair, Grounding System                    | 46   | 46  | 46    | 8      | 46    | 46    | 46  | 46  | 46    | 39    | 46   | 46  | 46    | 46     | 46    | 46   | 46  | 46    | 46  | 46  | 46    | 46  | 46  | 46    | 46     |     |
| Annual PM, Grounding System                            | 48   | 48  | 48    | 8      | 48    | 48    | 48  | 48  | 48    | 40    | 48   | 48  | 48    | 48     | 48    | 48   | 48  | 48    | 48  | 48  | 48    | 48  | 48  | 48    | 48     |     |
| Maintain Camera, Exterior, Closed Circuit, Fixed Color | 489  | 489 | 489   |        | 489   | 489   | 489 | 489 | 489   | 489   | 489  | 489 | 489   |        | 489   | 489  | 489 | 489   | 489 | 489 | 489   | 489 | 489 | 489   | 489    |     |
| Replace Heat Detector                                  |      |     |       |        |       |       |     |     |       |       |      |     |       |        | 3,360 |      |     |       |     |     |       |     |     |       |        |     |
| Repair Heat Detector                                   |      |     |       |        | 1,110 |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       | 1,110  |     |
| Check Operation, Heat Detector                         | 504  | 504 | 504   | 504    | 504   | 504   | 504 | 504 | 504   | 504   | 504  | 504 | 504   | 504    | 504   | 504  | 504 | 504   | 504 | 504 | 504   | 504 | 504 | 504   | 504    |     |
| Replace Headend Panel, Closed Circuit                  |      |     |       | 2,368  |       |       |     |     |       |       |      |     |       | 2,368  |       |      |     |       |     |     |       |     |     | 2,368 |        |     |
| Maintain Headend Panel, Closed Circuit                 | 21   | 21  | 21    |        | 21    | 21    | 21  | 21  | 21    | 21    | 21   | 21  | 21    |        | 21    | 21   | 21  | 21    | 21  | 21  | 21    | 21  | 21  | 21    | 21     |     |
| Replace Fire Alarm Horn & Strobe                       |      |     |       |        | 1,481 |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       | 1,481  |     |
| Replace Fire Alarm Bell, 6"                            |      |     |       |        | 1,142 |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       | 1,142  |     |
| Replace Electric Lock                                  |      |     |       | 537    |       |       |     |     |       |       |      |     |       | 537    |       |      |     |       |     |     |       |     |     |       | 537    |     |
| Replace Card Reader                                    |      |     |       | 1,859  |       |       |     |     |       |       |      |     |       | 1,859  |       |      |     |       |     |     |       |     |     |       | 1,859  |     |
| Maintain Card Reader                                   | 122  | 122 | 122   |        | 122   | 122   | 122 | 122 | 122   | 122   | 122  | 122 | 122   |        | 122   | 122  | 122 | 122   | 122 | 122 | 122   | 122 | 122 |       | 122    |     |
| Replace Camera, Exterior, Closed Circuit, Fixed Color  |      |     |       | 23,802 |       |       |     |     |       |       |      |     |       | 23,802 |       |      |     |       |     |     |       |     |     |       | 23,802 |     |
| Replace Intrusion Detection Motion Detector, Interior  |      |     |       | 1,305  |       |       |     |     |       |       |      |     |       | 1,305  |       |      |     |       |     |     |       |     |     |       | 1,305  |     |
| Replace Disconnect Switch, 600 Amp.                    |      |     |       |        |       |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       |        |     |
| Maintain Power Panel Board, 480 V, 200 Amp.            | 245  | 245 | 245   | 245    | 245   | 245   | 245 | 245 | 245   | 123   | 245  | 245 | 245   | 184    | 245   | 245  | 245 | 245   | 245 | 184 | 245   | 245 | 245 | 245   | 245    |     |
| Replace Exit Lighting Fixture, w/ Battery              |      |     |       |        |       |       |     | 350 |       |       |      |     |       |        |       |      |     | 700   |     |     |       |     |     |       |        |     |
| Repair Power Panel Board, 208 Y/120 V, 400 Amp.        |      |     |       | 98     |       |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     | 98    |     |     |       | 98     |     |
| Inspect & Clean Motor Starter, <5HP, <600V             | 286  | 286 | 286   | 286    | 286   | 286   | 286 | 286 | 286   | 286   | 286  | 286 | 286   | 286    |       | 286  | 286 | 286   | 286 | 286 | 286   | 286 | 286 | 286   | 286    |     |
| Replace Power Panel Board, 208 Y/120 V, 225 Amp.       |      |     |       |        |       |       |     |     |       |       |      |     | 6,385 | 19,154 |       |      |     |       |     |     | 6,385 |     |     |       |        |     |
| Repair Power Panel Board, 208 Y/120 V, 225 Amp.        | 98   |     | 98    | 294    |       |       |     |     |       |       | 98   |     |       |        |       |      |     |       |     |     |       |     | 98  | 294   |        |     |
| Maintain Power Panel Board, 208 Y/120 V, 225 Amp.      | 307  | 307 | 307   | 307    | 307   | 307   | 307 | 307 | 307   | 307   | 307  | 307 | 245   | 123    | 307   | 307  | 307 | 307   | 307 | 307 | 245   | 307 | 307 | 307   | 307    |     |
| Replace Power Panel Board, 208 Y/120 V, 100 Amp.       |      |     |       |        |       |       |     |     |       |       |      |     |       | 41,693 | 4,169 |      |     |       |     |     |       |     |     |       |        |     |
| Repair Power Panel Board, 208 Y/120 V, 100 Amp.        |      |     |       | 981    | 98    |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     | 981   | 98     |     |
| Maintain Power Panel Board, 208 Y/120 V, 100 Amp.      | 673  | 673 | 673   | 673    | 673   | 673   | 673 | 673 | 673   | 673   | 673  | 673 | 673   | 62     | 611   | 673  | 673 | 673   | 673 | 673 | 673   | 673 | 673 | 673   | 673    |     |
| Repair Power Panel Board, 480 V, 200 Amp.              |      |     |       | 98     |       |       |     |     |       | 98    |      |     |       |        |       |      |     |       |     |     | 197   |     |     |       | 98     |     |
| Replace Coil, Motor Starter, <5HP, <600V               |      |     | 1,408 |        |       | 1,408 |     |     | 1,408 |       |      |     | 1,408 |        |       |      |     | 1,408 |     |     |       |     |     | 1,408 |        |     |
| Replace Power Panel Board, 208 Y/120 V, 400 Amp.       |      |     |       |        |       |       |     |     |       | 7,591 |      |     |       | 7,591  |       |      |     |       |     |     |       |     |     |       |        |     |
| Maintain Disconnect Switch, 600 Amp.                   | 57   | 57  | 57    | 57     | 57    | 57    | 57  | 57  | 57    | 57    | 57   | 57  | 57    | 57     | 57    | 57   | 57  | 57    | 57  | 57  | 57    | 57  | 57  | 57    | 57     |     |
| Replace Disconnect Switch, 200 Amp.                    |      |     |       |        |       |       |     |     |       |       |      |     |       |        |       |      |     |       |     |     |       |     |     |       |        |     |
| Repair Disconnect Switch, 200 Amp.                     |      |     |       |        |       |       |     |     |       | 156   |      |     |       |        |       |      |     |       |     |     |       |     |     |       | 156    |     |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9     | 0     | 1     | 2   | 2043 | 4   | 5   | 6      | 7     | 2048 | 9     | 0   | 1     | 2     | 2053 | 4     | 5     | 6      | 7      | 2058  | 9     | 0   | 1   | 2   |     |  |  |
|--|------|-------|-------|-------|-----|------|-----|-----|--------|-------|------|-------|-----|-------|-------|------|-------|-------|--------|--------|-------|-------|-----|-----|-----|-----|--|--|
| Replace Public Address Speaker                         |      | 2,049 |       |       |     |      |     |     |        |       |      |       | 293 |       |       |      |       | 2,049 |        |        |       |       |     |     |     |     |  |  |
| Maintain Public Address Speaker                        | 162  | 162   | 21    | 162   | 162 | 162  | 162 | 162 | 162    | 162   | 162  | 162   | 141 | 162   | 162   | 162  | 162   | 21    | 162    | 162    | 162   | 162   | 162 | 162 | 162 | 162 |  |  |
| Replace Monitor, Small, Closed Circuit                 |      |       |       |       |     |      |     |     | 3,504  |       |      |       |     |       |       |      |       |       | 3,504  |        |       |       |     |     |     |     |  |  |
| Replace Manual Pull Station                            |      |       |       | 1,212 |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        | 1,212 |       |     |     |     |     |  |  |
| Check & Repair Manual Pull Station                     |      |       |       |       |     |      |     |     |        |       |      |       |     |       | 525   |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Maintain & Repair, Grounding System                    | 46   | 46    | 46    | 8     | 46  | 46   | 46  | 46  | 46     | 39    | 46   | 46    | 46  | 46    | 46    | 46   | 46    | 46    | 46     | 46     | 46    | 46    | 46  | 46  | 46  | 46  |  |  |
| Annual PM, Grounding System                            | 48   | 48    | 48    | 8     | 48  | 48   | 48  | 48  | 48     | 40    | 48   | 48    | 48  | 48    | 48    | 48   | 48    | 48    | 48     | 48     | 48    | 48    | 48  | 48  | 48  | 48  |  |  |
| Maintain Camera, Exterior, Closed Circuit, Fixed Color | 489  | 489   | 489   | 489   | 489 | 489  | 489 | 489 |        | 489   | 489  | 489   | 489 | 489   | 489   | 489  | 489   | 489   | 489    |        | 489   | 489   | 489 | 489 | 489 |     |  |  |
| Replace Heat Detector                                  |      |       |       | 3,360 |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        | 3,360 |       |     |     |     |     |  |  |
| Repair Heat Detector                                   |      |       |       |       |     |      |     |     |        |       |      |       |     |       | 1,110 |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Check Operation, Heat Detector                         | 504  | 504   | 504   | 504   |     | 504  | 504 | 504 | 504    | 504   | 504  | 504   | 504 | 504   | 504   | 504  | 504   | 504   | 504    |        | 504   | 504   | 504 | 504 | 504 |     |  |  |
| Replace Headend Panel, Closed Circuit                  |      |       |       |       |     |      |     |     | 2,368  |       |      |       |     |       |       |      |       |       | 2,368  |        |       |       |     |     |     |     |  |  |
| Maintain Headend Panel, Closed Circuit                 | 21   | 21    | 21    | 21    | 21  | 21   | 21  |     |        | 21    | 21   | 21    | 21  | 21    | 21    | 21   | 21    | 21    | 21     |        | 21    | 21    | 21  | 21  | 21  |     |  |  |
| Replace Fire Alarm Horn & Strobe                       |      |       |       |       |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        | 1,481 |       |     |     |     |     |  |  |
| Replace Fire Alarm Bell, 6"                            |      |       |       |       |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        | 1,142 |       |     |     |     |     |  |  |
| Replace Electric Lock                                  |      |       |       |       |     |      |     |     | 537    |       |      |       |     |       |       |      |       |       |        | 537    |       |       |     |     |     |     |  |  |
| Replace Card Reader                                    |      |       |       |       |     |      |     |     | 1,859  |       |      |       |     |       |       |      |       |       |        | 1,859  |       |       |     |     |     |     |  |  |
| Maintain Card Reader                                   | 122  | 122   | 122   | 122   | 122 | 122  | 122 |     |        | 122   | 122  | 122   | 122 | 122   | 122   | 122  | 122   | 122   |        |        | 122   | 122   | 122 | 122 | 122 |     |  |  |
| Replace Camera, Exterior, Closed Circuit, Fixed Color  |      |       |       |       |     |      |     |     | 23,802 |       |      |       |     |       |       |      |       |       | 23,802 |        |       |       |     |     |     |     |  |  |
| Replace Intrusion Detection Motion Detector, Interior  |      |       |       |       |     |      |     |     | 1,305  |       |      |       |     |       |       |      |       |       |        | 1,305  |       |       |     |     |     |     |  |  |
| Replace Disconnect Switch, 600 Amp.                    |      |       |       | 6,799 |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Maintain Power Panel Board, 480 V, 200 Amp.            | 245  | 245   | 245   | 245   | 245 | 245  | 245 | 245 | 245    | 245   | 245  | 245   | 245 | 245   | 123   | 245  | 245   | 245   | 184    | 245    | 245   | 245   | 245 | 245 | 184 |     |  |  |
| Replace Exit Lighting Fixture, w/ Battery              |      |       | 350   |       |     |      |     |     |        |       |      |       | 700 |       |       |      |       |       |        |        | 350   |       |     |     |     |     |  |  |
| Repair Power Panel Board, 208 Y/120 V, 400 Amp.        |      |       |       | 98    |     |      |     |     | 98     |       |      |       |     |       |       |      |       |       |        |        |       |       |     |     | 98  |     |  |  |
| Inspect & Clean Motor Starter, <5HP, <600V             | 286  | 286   | 286   | 286   | 286 | 286  | 286 |     | 286    | 286   | 286  | 286   | 286 | 286   | 286   | 286  | 286   | 286   | 286    | 286    | 286   | 286   | 286 | 286 | 286 |     |  |  |
| Replace Power Panel Board, 208 Y/120 V, 225 Amp.       |      |       |       |       |     |      |     |     |        |       |      |       |     |       |       |      |       | 6,385 |        | 19,154 |       |       |     |     |     |     |  |  |
| Repair Power Panel Board, 208 Y/120 V, 225 Amp.        |      |       |       |       | 98  |      |     | 98  | 294    |       |      |       |     |       | 98    |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Maintain Power Panel Board, 208 Y/120 V, 225 Amp.      | 307  | 307   | 307   | 307   | 307 | 307  | 307 | 307 | 307    | 307   | 307  | 307   | 307 | 307   | 307   | 307  | 307   | 245   | 123    | 307    | 307   | 307   | 307 | 307 | 307 |     |  |  |
| Replace Power Panel Board, 208 Y/120 V, 100 Amp.       |      |       |       |       |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        | 41,693 |       | 4,169 |     |     |     |     |  |  |
| Repair Power Panel Board, 208 Y/120 V, 100 Amp.        |      |       |       |       |     |      |     |     | 981    |       | 98   |       |     |       |       |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Maintain Power Panel Board, 208 Y/120 V, 100 Amp.      | 673  | 673   | 673   | 673   | 673 | 673  | 673 | 673 | 673    | 673   | 673  | 673   | 673 | 673   | 673   | 673  | 673   | 673   | 673    | 62     | 611   | 673   | 673 | 673 | 673 |     |  |  |
| Repair Power Panel Board, 480 V, 200 Amp.              |      |       |       |       | 295 |      |     | 98  |        |       |      |       |     |       | 98    |      |       |       |        |        |       |       |     |     | 197 |     |  |  |
| Replace Coil, Motor Starter, <5HP, <600V               |      | 1,408 |       | 1,408 |     |      |     |     |        | 1,408 |      | 1,408 |     |       | 1,408 |      | 1,408 |       |        | 1,408  |       | 1,408 |     |     |     |     |  |  |
| Replace Power Panel Board, 208 Y/120 V, 400 Amp.       |      |       |       |       |     |      |     |     |        |       |      |       |     | 7,591 |       |      |       | 7,591 |        |        |       |       |     |     |     |     |  |  |
| Maintain Disconnect Switch, 600 Amp.                   | 57   | 57    | 57    | 57    |     | 57   | 57  | 57  | 57     | 57    | 57   | 57    | 57  | 57    | 57    | 57   | 57    | 57    | 57     | 57     | 57    | 57    | 57  | 57  | 57  |     |  |  |
| Replace Disconnect Switch, 200 Amp.                    |      |       | 1,361 |       |     |      |     |     |        |       |      |       |     |       |       |      |       |       |        |        |       |       |     |     |     |     |  |  |
| Repair Disconnect Switch, 200 Amp.                     |      |       |       |       |     |      |     |     |        |       |      |       |     |       | 156   |      |       |       |        |        |       |       | 156 |     |     |     |  |  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:   | 2013  | 4   | 5     | 6   | 7      | 2018 | 9     | 0   | 1     | 2      | 2023   | 4   | 5     | 6      | 7     | 2028  | 9     | 0   | 1     | 2     | 2033  | 4   | 5     | 6   | 7      |
|--|-------|-----|-------|-----|--------|------|-------|-----|-------|--------|--------|-----|-------|--------|-------|-------|-------|-----|-------|-------|-------|-----|-------|-----|--------|
| Maintain Disconnect Switch, 200 Amp.                         | 57    | 57  | 57    | 57  | 57     | 57   | 57    | 57  | 57    | 57     | 57     | 57  | 57    | 57     | 57    | 57    | 57    | 57  | 57    | 57    | 57    | 57  | 57    | 57  | 57     |
| Replace Disconnect Switch, 60 Amp.                           |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Repair Disconnect Switch, 60 Amp.                            |       | 131 |       |     |        |      |       |     | 525   |        |        | 131 |       |        |       |       |       |     |       | 525   |       | 131 |       |     |        |
| Maintain Disconnect Switch, 60 Amp.                          | 102   | 102 | 102   | 102 | 102    | 102  | 102   | 102 | 102   | 102    | 102    | 102 | 102   | 102    | 102   | 102   | 102   | 102 | 102   | 102   | 102   | 102 | 102   | 102 | 102    |
| Replace Disconnect Switch, 30 Amp.                           |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Repair Disconnect Switch, 30 Amp.                            |       |     |       |     | 511    |      |       |     | 2,043 |        |        |     |       |        | 511   |       |       |     |       | 2,043 |       |     |       |     | 511    |
| Maintain Disconnect Switch, 30 Amp.                          | 404   | 404 | 404   | 404 | 404    | 404  | 404   | 404 | 404   | 404    | 404    | 404 | 404   | 404    | 404   | 404   | 404   | 404 | 404   | 404   | 404   | 404 | 404   | 404 | 404    |
| Replace Motor Starter, <5HP, <600V                           |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       | 3,982 |       |     |       |       |       |     |       |     |        |
| Inspect & Clean Variable Frequency Drive, <600 V             | 62    | 62  | 62    | 62  | 62     | 62   | 62    | 62  | 62    | 62     | 62     | 62  | 62    | 62     | 62    | 62    | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62     |
| Replace Lamp, Exit Lighting Fixture, w/ Battery              |       |     | 230   |     |        |      |       |     | 153   |        |        |     | 230   |        |       |       |       |     |       | 77    |       |     | 230   |     |        |
| Replace Emergency Lighting Pack, 2 Light w/ Battery          |       |     |       |     | 19,357 |      |       |     | 6,452 |        |        |     |       |        |       |       |       |     |       | 4,302 |       |     |       |     | 19,357 |
| Replace Lens, Replace Emergency Lighting Pack, 2 Light w/ Ba |       |     |       |     |        |      |       |     | 133   |        |        |     |       |        | 598   |       |       |     |       | 200   |       |     |       |     |        |
| Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/ B  | 1,215 | 675 | 1,215 | 675 |        | 675  | 1,215 | 270 | 1,215 | 675    | 1,215  | 675 | 1,215 | 675    | 1,215 | 675   | 1,215 | 405 | 1,215 | 675   | 1,215 | 675 | 1,215 | 675 |        |
| Replace Compact Fluorescent Lighting Fixture, 32 w           |       |     | 377   |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     | 377   |     |        |
| Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtur |       |     |       |     |        |      |       |     |       |        |        |     | 335   |        |       |       |       |     |       |       |       |     |       |     |        |
| Maintain Power Panel Board, 208 Y/120 V, 400 Amp.            | 123   | 123 | 123   | 123 | 123    | 123  | 123   | 123 | 123   | 62     | 123    | 123 | 123   | 62     | 123   | 123   | 123   | 123 | 123   | 123   | 123   | 123 | 123   | 123 | 123    |
| Replace Coil, Variable Frequency Drive, <600V                |       |     | 143   |     |        |      |       |     | 143   |        |        |     |       |        |       | 143   |       |     |       |       | 143   |     |       |     |        |
| Replace Power Panel Board, 480 V, 200 Amp.                   |       |     |       |     |        |      |       |     |       | 16,321 |        |     |       | 8,160  |       |       |       |     |       | 8,160 |       |     |       |     |        |
| Replace Secondary Transformer, Dry, 150 kVA                  |       |     |       |     |        |      |       |     |       | 12,484 |        |     |       | 12,484 |       |       |       |     |       |       |       |     |       |     |        |
| Repair Secondary Transformer, Dry, 150 kVA                   |       |     |       | 283 |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       | 283   |     |       |     | 283    |
| Maintain Secondary Transformer, Dry, 150 kVA                 | 123   | 123 | 123   | 123 | 123    | 123  | 123   | 123 | 123   | 62     | 123    | 123 | 123   | 62     | 123   | 123   | 123   | 123 | 123   | 123   | 123   | 123 | 123   | 123 | 123    |
| Replace Power Panel Board, 480 V, 400 Amp.                   |       |     |       |     |        |      |       |     |       | 9,529  |        |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Replace Variable Frequency Drive, <600V                      |       |     |       |     |        |      |       |     |       |        | 14,633 |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Repair Power Panel Board, 480 V, 400 Amp.                    |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     | 136    |
| Replace Secondary Transformer, Dry, 45 kVA                   |       |     |       |     |        |      |       |     |       | 5,523  |        |     |       | 5,523  |       |       |       |     |       |       |       |     |       |     |        |
| Maintain Power Panel Board, 480 V, 1,000 Amp.                | 62    | 62  | 62    | 62  | 62     | 62   | 62    | 62  | 62    |        | 62     | 62  | 62    | 62     | 62    | 62    | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62     |
| Repair Power Panel Board, 480 V, 1,000 Amp.                  |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     | 724    |
| Replace Power Panel Board, 480 V, 1,000 Amp.                 |       |     |       |     |        |      |       |     |       |        | 13,779 |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Maintain Secondary Transformer, Dry, 15 kVA                  | 62    | 62  | 62    | 62  | 62     | 62   | 62    | 62  | 62    |        | 62     | 62  | 62    | 62     | 62    | 62    | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62     |
| Repair Secondary Transformer, Dry, 15 kVA                    |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     | 283    |
| Replace Secondary Transformer, Dry, 15 kVA                   |       |     |       |     |        |      |       |     |       |        | 4,038  |     |       |        |       |       |       |     |       |       |       |     |       |     |        |
| Maintain Secondary Transformer, Dry, 45 kVA                  | 123   | 123 | 123   | 123 | 123    | 123  | 123   | 123 | 123   | 62     | 123    | 123 | 123   | 62     | 123   | 123   | 123   | 123 | 123   | 123   | 123   | 123 | 123   | 123 | 123    |
| Repair Secondary Transformer, Dry, 45 kVA                    |       |     |       |     |        |      |       |     |       |        |        |     |       |        |       |       |       |     |       |       |       |     |       |     | 283    |
| Maintain Power Panel Board, 480 V, 400 Amp.                  | 62    | 62  | 62    | 62  | 62     | 62   | 62    | 62  | 62    |        | 62     | 62  | 62    | 62     | 62    | 62    | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62     |

## G20 Site Improvements

|                               |       |       |       |       |       |       |       |       |       |  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Maintain Manual Swing Gates   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   |  | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   |
| Maintain Chain Link Fence, 8' | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 |  | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 |

# M&R Costs by Task

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:  | 2038 | 9     | 0   | 1      | 2   | 2043  | 4   | 5     | 6   | 7     | 2048  | 9     | 0   | 1     | 2   | 2053  | 4      | 5     | 6   | 7     | 2058   | 9     | 0      | 1     | 2      |
|---|------|-------|-----|--------|-----|-------|-----|-------|-----|-------|-------|-------|-----|-------|-----|-------|--------|-------|-----|-------|--------|-------|--------|-------|--------|
| Maintain Disconnect Switch, 200 Amp.                        | 57   | 57    | 57  |        |     | 57    | 57  | 57    | 57  | 57    | 57    | 57    | 57  | 57    | 57  | 57    | 57     | 57    | 57  | 57    | 57     | 57    | 57     | 57    | 57     |
| Replace Disconnect Switch, 60 Amp.                          |      |       |     | 3,126  |     |       |     |       |     |       |       |       |     |       |     |       | 781    |       |     |       |        |       |        |       |        |
| Repair Disconnect Switch, 60 Amp.                           |      |       |     |        |     |       | 131 |       |     |       |       |       |     |       |     |       | 525    |       |     |       |        |       |        | 525   |        |
| Maintain Disconnect Switch, 60 Amp.                         | 102  | 102   | 102 | 21     | 102 | 102   | 102 | 102   | 102 | 102   | 102   | 102   | 102 | 102   | 102 | 102   | 81     | 102   | 102 | 102   | 102    | 102   | 102    | 102   | 102    |
| Replace Disconnect Switch, 30 Amp.                          |      |       |     | 5,577  |     |       |     |       |     |       | 1,394 |       |     |       |     |       |        |       |     |       |        |       |        |       |        |
| Repair Disconnect Switch, 30 Amp.                           |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     | 2,043 |        |       |     | 511   |        |       |        | 2,043 |        |
| Maintain Disconnect Switch, 30 Amp.                         | 404  | 404   | 404 | 81     | 404 | 404   | 404 | 404   | 404 | 323   | 404   | 404   | 404 | 404   | 404 | 404   | 404    | 404   | 404 | 404   | 404    | 404   | 404    | 404   | 404    |
| Replace Motor Starter, <5HP, <600V                          |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       |        |
| Inspect & Clean Variable Frequency Drive, <600 V            | 62   | 62    | 62  |        | 62  | 62    | 62  | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62    | 62     | 62    | 62  | 62    | 62     | 62    | 62     | 62    | 62     |
| Replace Lamp, Exit Lighting Fixture, w/ Battery             |      |       |     | 153    |     |       |     |       |     |       |       |       |     |       |     |       | 77     |       |     | 230   |        |       |        | 153   |        |
| Replace Emergency Lighting Pack, 2 Light w/ Battery         |      |       |     | 6,452  |     |       |     |       |     |       |       |       |     |       |     |       | 4,302  |       |     |       | 19,357 |       |        | 6,452 |        |
| Replace Lens, Replace Emergency Lighting Pack, 2 Light w/   |      |       |     | 133    |     |       |     |       |     |       |       |       |     |       |     |       | 200    |       |     |       |        |       |        | 133   |        |
| Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/   | 675  | 1,215 | 270 | 1,215  | 675 | 1,215 | 675 | 1,215 | 675 | 1,215 | 675   | 1,215 | 405 | 1,215 | 675 | 1,215 | 675    | 1,215 | 675 |       | 675    | 1,215 | 270    | 1,215 | 675    |
| Replace Compact Fluorescent Lighting Fixture, 32 w          |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       |        |
| Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtu |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       |        |
| Maintain Power Panel Board, 208 Y/120 V, 400 Amp.           | 123  | 123   | 123 | 123    | 123 | 123   | 123 | 123   | 123 | 123   | 123   | 123   | 123 | 62    | 123 | 123   | 123    | 62    | 123 | 123   | 123    | 123   | 123    | 123   | 123    |
| Replace Coil, Variable Frequency Drive, <600V               | 143  |       |     |        |     |       |     |       | 143 |       |       |       |     |       |     |       | 143    |       |     |       |        |       |        |       |        |
| Replace Power Panel Board, 480 V, 200 Amp.                  |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       | 16,321 |       |     |       | 8,160  |       |        |       | 8,160  |
| Replace Secondary Transformer, Dry, 150 kVA                 |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       | 12,484 |       |     |       | 12,484 |       |        |       |        |
| Repair Secondary Transformer, Dry, 150 kVA                  |      |       |     |        | 283 |       |     |       | 283 |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 283    |
| Maintain Secondary Transformer, Dry, 150 kVA                | 123  | 123   | 123 | 123    | 123 | 123   | 123 | 123   | 123 | 123   | 123   | 123   | 123 | 62    | 123 | 123   | 123    | 62    | 123 | 123   | 123    | 123   | 123    | 123   | 123    |
| Replace Power Panel Board, 480 V, 400 Amp.                  |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       | 9,529  |       |     |       |        |       |        |       |        |
| Replace Variable Frequency Drive, <600V                     |      |       |     | 14,633 |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       | 14,633 |       |        |
| Repair Power Panel Board, 480 V, 400 Amp.                   |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 136    |
| Replace Secondary Transformer, Dry, 45 kVA                  |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       | 5,523  |       |     | 5,523 |        |       |        |       |        |
| Maintain Power Panel Board, 480 V, 1,000 Amp.               | 62   | 62    | 62  | 62     | 62  | 62    | 62  | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62    | 62     | 62    | 62  | 62    | 62     | 62    | 62     | 62    | 62     |
| Repair Power Panel Board, 480 V, 1,000 Amp.                 |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 724    |
| Replace Power Panel Board, 480 V, 1,000 Amp.                |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 13,779 |
| Maintain Secondary Transformer, Dry, 15 kVA                 | 62   | 62    | 62  | 62     | 62  | 62    | 62  | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62    | 62     | 62    | 62  | 62    | 62     | 62    | 62     | 62    | 62     |
| Repair Secondary Transformer, Dry, 15 kVA                   |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 283    |
| Replace Secondary Transformer, Dry, 15 kVA                  |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 4,038  |
| Maintain Secondary Transformer, Dry, 45 kVA                 | 123  | 123   | 123 | 123    | 123 | 123   | 123 | 123   | 123 | 123   | 123   | 123   | 123 | 62    | 123 | 123   | 123    | 62    | 123 | 123   | 123    | 123   | 123    | 123   | 123    |
| Repair Secondary Transformer, Dry, 45 kVA                   |      |       |     |        |     |       |     |       |     |       |       |       |     |       |     |       |        |       |     |       |        |       |        |       | 283    |
| Maintain Power Panel Board, 480 V, 400 Amp.                 | 62   | 62    | 62  | 62     | 62  | 62    | 62  | 62    | 62  | 62    | 62    | 62    | 62  | 62    | 62  | 62    | 62     | 62    | 62  | 62    | 62     | 62    | 62     | 62    | 62     |

## G20 Site Improvements

|                               |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Maintain Manual Swing Gates   | 268   | 268   | 268   |       | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   | 268   |
| Maintain Chain Link Fence, 8' | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 | 1,131 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

| Forecast Year:                                     | 2013 | 4   | 5   | 6     | 7   | 2018 | 9   | 0   | 1      | 2 | 2023 | 4   | 5   | 6     | 7   | 2028 | 9   | 0   | 1     | 2 | 2033 | 4   | 5   | 6     | 7   |
|--|------|-----|-----|-------|-----|------|-----|-----|--------|---|------|-----|-----|-------|-----|------|-----|-----|-------|---|------|-----|-----|-------|-----|
| Replace Chain Link Fence Pedestrian Gate, 4' Wide  |      |     |     |       |     |      |     |     | 422    |   |      |     |     |       |     |      |     |     | 422   |   |      |     |     |       |     |
| Replace Double Swing Gates                         |      |     |     |       |     |      |     |     | 3,290  |   |      |     |     |       |     |      |     |     | 3,290 |   |      |     |     |       |     |
| Replace 2" Gate Posts, Pedestrian Gate             |      |     |     | 730   |     |      |     |     |        |   |      |     |     | 730   |     |      |     |     |       |   |      |     |     | 730   |     |
| Replace 3" Gate Post                               |      |     |     | 2,673 |     |      |     |     |        |   |      |     |     | 2,673 |     |      |     |     |       |   |      |     |     | 2,673 |     |
| Replace Chain Link Fence, 8'                       |      |     |     |       |     |      |     |     | 25,165 |   |      |     |     |       |     |      |     |     |       |   |      |     |     |       |     |
| Maintain Chain Link Fence Pedestrian Gate, 4' Wide | 134  | 134 | 134 | 134   | 134 | 134  | 134 | 134 |        |   | 134  | 134 | 134 | 134   | 134 | 134  | 134 | 134 |       |   | 134  | 134 | 134 | 134   | 134 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Materials Combustion Research Facil **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/268

**City:** Huntsville, AL

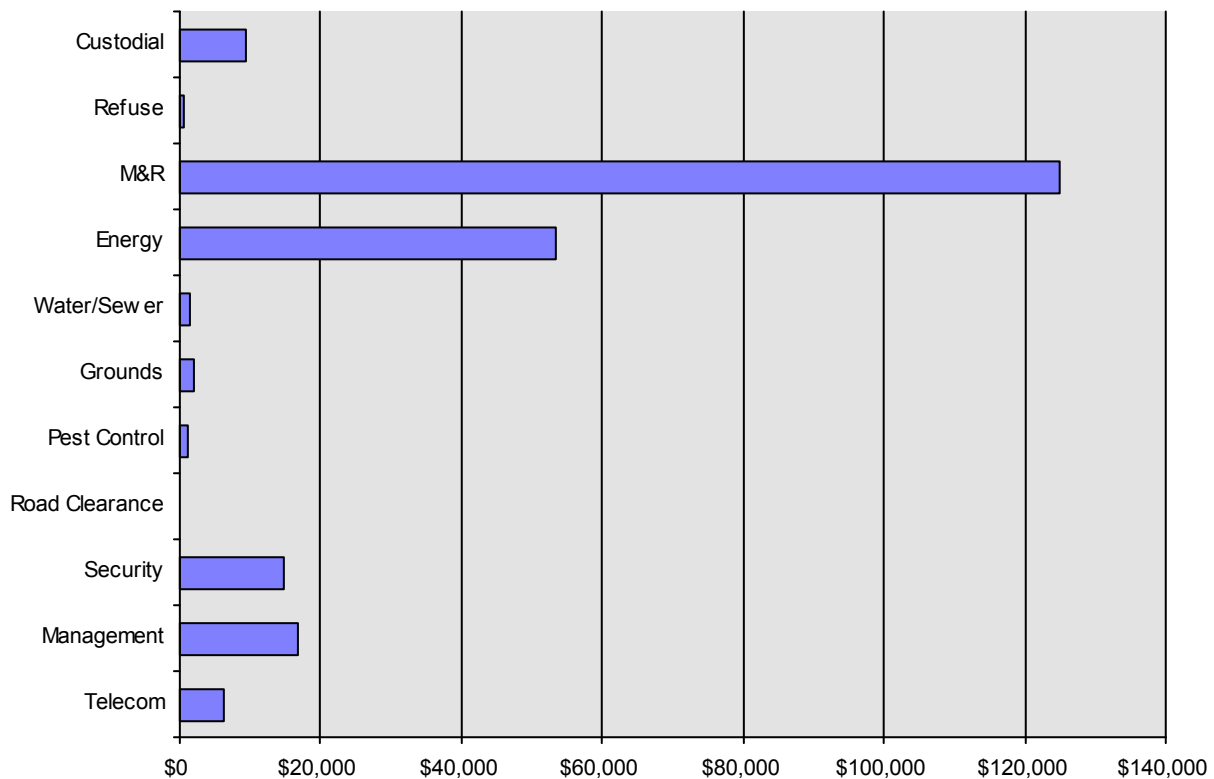
| Forecast Year:                                     | 2038 | 9   | 0   | 1     | 2 | 2043 | 4   | 5   | 6     | 7   | 2048 | 9   | 0   | 1      | 2   | 2053 | 4   | 5   | 6     | 7   | 2058 | 9   | 0   | 1   | 2     |
|--|------|-----|-----|-------|---|------|-----|-----|-------|-----|------|-----|-----|--------|-----|------|-----|-----|-------|-----|------|-----|-----|-----|-------|
| Replace Chain Link Fence Pedestrian Gate, 4' Wide  |      |     |     | 422   |   |      |     |     |       |     |      |     |     | 422    |     |      |     |     |       |     |      |     |     |     | 422   |
| Replace Double Swing Gates                         |      |     |     | 3,290 |   |      |     |     |       |     |      |     |     | 3,290  |     |      |     |     |       |     |      |     |     |     | 3,290 |
| Replace 2" Gate Posts, Pedestrian Gate             |      |     |     |       |   |      |     |     | 730   |     |      |     |     |        |     |      |     |     | 730   |     |      |     |     |     |       |
| Replace 3" Gate Post                               |      |     |     |       |   |      |     |     | 2,673 |     |      |     |     |        |     |      |     |     | 2,673 |     |      |     |     |     |       |
| Replace Chain Link Fence, 8'                       |      |     |     |       |   |      |     |     |       |     |      |     |     | 25,165 |     |      |     |     |       |     |      |     |     |     |       |
| Maintain Chain Link Fence Pedestrian Gate, 4' Wide | 134  | 134 | 134 |       |   | 134  | 134 | 134 | 134   | 134 | 134  | 134 | 134 | 134    | 134 | 134  | 134 | 134 | 134   | 134 | 134  | 134 | 134 | 134 | 134   |

# Operation Costs Summary

Whitestone Research

**Building:** Materials Combustion Research Facili      **GSFT:** 15,211  
**Building Number:** 1045/62/268      **Replacement Value:** \$6,713,582  
**Facility:** Marshall Space Flight Center      **Building Use:** Laboratory  
**City:** Huntsville, AL      **Building Type:** Propulsion Building  
**Built Date:** 1960

| Operation             | Annual Cost/GSFT | Annual Total     | Percent       |
|-----------------------|------------------|------------------|---------------|
| Custodial             | \$0.621          | \$9,452          | 4.1%          |
| Energy                | \$3.519          | \$53,527         | 23.2%         |
| Grounds               | \$0.125          | \$1,907          | 0.8%          |
| M&R                   | \$8.223          | \$125,075        | 54.2%         |
| Management            | \$1.103          | \$16,784         | 7.3%          |
| Pest Control          | \$0.067          | \$1,018          | 0.4%          |
| Refuse                | \$0.033          | \$505            | 0.2%          |
| Road Clearance        | \$0.002          | \$35             | 0.0%          |
| Security              | \$0.963          | \$14,652         | 6.4%          |
| Telecom               | \$0.414          | \$6,303          | 2.7%          |
| Water/Sewer           | \$0.091          | \$1,381          | 0.6%          |
| <b>Building Total</b> | <b>\$15.16</b>   | <b>\$230,639</b> | <b>100.0%</b> |



# Building Operations Task Details

Whitestone Research

**Building:** Materials Combustion Research Facilit

**Year Built:** 1960

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/268

**City:** Huntsville, AL

**Replacement Value:** \$6,713,582      **per SF:** \$441

**Building Gsft:** 15,211

| Functional Area             | FA GSFT | Task   | Labor Cost     | Material Cost  | Task Cost      |
|-----------------------------|---------|--|----------------|----------------|----------------|
| <b>Operation: Custodial</b> |         | <b>Level of Service: Low</b>   |                |                |                |
| Laboratory                  | 10039   | Wet Mop & Rinse Hard Floor with 32 oz. Mop Using Single Bucket & Wringer                       | \$3,007        | \$489          | \$3,496        |
| Laboratory                  | 10039   | Empty Trash; Wipe Clean & Re-line Basket   | \$1,002        | \$163          | \$1,165        |
| Laboratory                  | 10039   | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$615          | \$100          | \$715          |
| Laboratory                  | 10039   | Dust Surfaces with Duster  | \$463          | \$75           | \$538          |
| Laboratory                  | 10039   | Dust Window Blinds   | \$222          | \$36           | \$258          |
| Office                      | 1216    | Vacuum Carpet with 14" Upright Vacuum  | \$425          | \$69           | \$494          |
| Office                      | 1216    | Empty Trash; Wipe Clean & Re-line Basket   | \$121          | \$20           | \$141          |
| Office                      | 1216    | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$75           | \$12           | \$87           |
| Office                      | 1216    | Dust Surfaces with Duster  | \$56           | \$9            | \$65           |
| Office                      | 1216    | Vacuum Upholstered Furniture with Tank or Canister Vacuum                                      | \$47           | \$8            | \$54           |
| Office                      | 1216    | Dust Window Blinds   | \$27           | \$4            | \$31           |
| Shop                        | 912     | Damp Mop Hard Floors with 24 oz. Mop Head Using Double Bucket & Wringer                        | \$333          | \$54           | \$387          |
| Shop                        | 912     | Empty Trash; Wipe Clean & Re-line Basket   | \$126          | \$20           | \$147          |
| Storage                     | 912     | Sweep Hard Floor with 48" Push Broom   | \$16           | \$3            | \$19           |
| Storage                     | 912     | Empty Trash; Wipe Clean & Re-line Basket   | \$11           | \$2            | \$12           |
| Common/Circulation Are      | 760     | Vacuum Carpet with 14" Upright Vacuum  | \$531          | \$86           | \$617          |
| Common/Circulation Are      | 760     | Empty Trash; Wipe Clean & Re-line Basket   | \$76           | \$12           | \$88           |
| Common/Circulation Are      | 760     | Vacuum Upholstered Furniture with Tank or Canister Vacuum                                      | \$58           | \$9            | \$68           |
| Mechanical/Equipment        | 760     | Sweep Hard Floor with 48" Push Broom   | \$14           | \$2            | \$16           |
| Mechanical/Equipment        | 760     | Empty Trash; Wipe Clean & Re-line Basket   | \$9            | \$1            | \$10           |
| Restroom                    | 304     | Service Restroom: Empty Trash, Clean & Disinfect Fixtures, Wipe Mirrors, Replace Supplies, Wet | \$637          | \$104          | \$741          |
| Conference Room             | 304     | Vacuum Carpet with 14" Upright Vacuum  | \$106          | \$17           | \$123          |
| Restroom                    | 304     | Service Restroom: Empty Trash, Replace Supplies & Touch Up as Needed                           | \$98           | \$16           | \$114          |
| Conference Room             | 304     | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$40           | \$7            | \$47           |
| Conference Room             | 304     | Empty Trash; Wipe Clean & Re-line Basket   | \$15           | \$2            | \$18           |
| <b>Total:</b>               |         |  | <b>\$8,131</b> | <b>\$1,321</b> | <b>\$9,452</b> |
| <b>Operation: Grounds</b>   |         | <b>Level of Service: Low</b>   |                |                |                |



| Functional Area                  | FA GSFT | Task   | Labor Cost     | Material Cost | Task Cost      |
|----------------------------------|---------|--|----------------|---------------|----------------|
| Grounds, Improved                | 9126    | Mow Turfgrass with 21" Power Mower             | \$337          | \$140         | \$477          |
| Grounds, Improved                | 9126    | Aerate Improved Grounds                        | \$261          | \$109         | \$370          |
| Grounds, Improved                | 9126    | Clear Shrubs                                   | \$218          | \$91          | \$309          |
| Grounds, Improved                | 9126    | Edge Clean & Trim Walks with Gas Powered Edger | \$140          | \$58          | \$198          |
| Grounds, Improved                | 9126    | Overseed, Improved Grounds                     | \$131          | \$54          | \$185          |
| Grounds, Improved                | 9126    | Vacuum with 30" Billy Goat                     | \$87           | \$36          | \$124          |
| Grounds, Improved                | 9126    | Clear Crabgrass                                | \$65           | \$27          | \$93           |
| Grounds, Improved                | 9126    | Clear Weeds with 15" Boom, Improved Grounds    | \$35           | \$14          | \$49           |
| Grounds, Improved                | 9126    | Trim Around Raised Objects with String Edger   | \$29           | \$12          | \$41           |
| Grounds, Improved                | 9126    | Fertilize Improved Grounds                     | \$26           | \$11          | \$37           |
| Grounds, Improved                | 9126    | Sweep with 30" Power Rake                      | \$17           | \$7           | \$24           |
| Grounds, Improved                | 9126    | Fertilize Using Power Take Off Broadcast       | \$0            | \$0           | \$0            |
| <b>Total:</b>                    |         |  | <b>\$1,347</b> | <b>\$560</b>  | <b>\$1,907</b> |
| <b>Operation: Pest Control</b>   |         | <b>Level of Service: Medium</b>                |                |               |                |
| Pest Controlled                  | 15211   | Install, or Check and Re-Bait 5 Rodent Boxes   | \$351          | \$146         | \$498          |
| Pest Controlled                  | 15211   | Perform Crawling Insect Abatement              | \$264          | \$110         | \$374          |
| Pest Controlled                  | 15211   | Inspect Building for Pests                     | \$147          | \$0           | \$147          |
| <b>Total:</b>                    |         |  | <b>\$762</b>   | <b>\$256</b>  | <b>\$1,018</b> |
| <b>Operation: Road Clearance</b> |         | <b>Level of Service: Medium</b>                |                |               |                |
| Pavement NASA                    | 12168   | Plow Paved Area                                | \$27           | \$8           | \$35           |
| <b>Total:</b>                    |         |  | <b>\$27</b>    | <b>\$8</b>    | <b>\$35</b>    |
| <b>Operation: Security</b>       |         | <b>Level of Service: Medium</b>                |                |               |                |
| Secured Area                     | 15211   | Patrol Building Perimeter                      | \$2,891        | \$470         | \$3,361        |
| Secured Area                     | 15211   | Guard Lobby/Parking                            | \$0            | \$0           | \$0            |
| <b>Total:</b>                    |         |  | <b>\$2,891</b> | <b>\$470</b>  | <b>\$3,361</b> |

# Building Operations Utility Details

Whitestone Research

**Building:** Materials Combustion Research Facilit

**Year Built:** 1960

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/268

**City:** Huntsville, AL

**Replacement Value:** \$6,713,582 **per SF:** \$441

**Building Gsft:** 15,211

|                               | Utility                         | GSFT  | Demand        | UM  | Rate     | Cost            |
|-------------------------------|---------------------------------|-------|---------------|-----|----------|-----------------|
| <b>Operation:</b> Energy      | <b>Level of Service:</b> Medium |       |               |     |          |                 |
|                               | Electricity                     | 15211 | 35.435        | kWh | \$0.0833 | \$44,899        |
|                               | Natural Gas                     | 15211 | 0.718         | Thm | \$0.7900 | \$8,628         |
|                               | Diesel                          | 15211 | 0.000         | Gal | \$3.2100 | \$0             |
|                               | <b>Total:</b>                   |       | <b>36.153</b> |     |          | <b>\$53,527</b> |
| <b>Operation:</b> Refuse      | <b>Level of Service:</b> Medium |       |               |     |          |                 |
|                               | Municipal Solid Waste           | 15211 | 0.370         | Lbs | \$0.0717 | \$404           |
|                               | Recycling                       | 15211 | 0.180         | Lbs | \$0.0370 | \$101           |
|                               | <b>Total:</b>                   |       | <b>0.550</b>  |     |          | <b>\$505</b>    |
| <b>Operation:</b> Water/Sewer | <b>Level of Service:</b> Medium |       |               |     |          |                 |
|                               | Sewer                           | 15211 | 18.920        | Gal | \$0.0034 | \$978           |
|                               | Water                           | 15211 | 24.080        | Gal | \$0.0011 | \$403           |
|                               | <b>Total:</b>                   |       | <b>43.000</b> |     |          | <b>\$1,381</b>  |

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## Building Operations Management Details

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Whitestone Research

**Building:** Materials Combustion Research Facilit

**Year Built:** 1960

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/268

**City:** Huntsville, AL

**Replacement Value:** \$6,713,582

**per SF:** \$441

**Building Gsft:** 15,211

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|                              | Service                      | Demand | UM  | PRV         | Cost            |
|------------------------------|------------------------------|--------|-----|-------------|-----------------|
| <b>Operation:</b> Management | <b>Level of Service:</b> Low |        |     |             |                 |
|                              | Management                   | 0.3%   | PRV | \$6,713,582 | \$16,784        |
|                              | <b>Total:</b>                |        |     |             | <b>\$16,784</b> |

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# Building Operations Service Details

Whitestone Research

**Building:** Materials Combustion Research Facilit

**Year Built:** 1960

**FTEs:** 7

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/268

**City:** Huntsville, AL

**Replacement Value:** \$6,713,582

**per SF:** \$441

**Building Gsft:** 15,211

|                   |                 | Service*                        | Quantity | Rate    | Cost            |
|-------------------|-----------------|---------------------------------|----------|---------|-----------------|
| <b>Operation:</b> | <b>Security</b> | <b>Level of Service: Medium</b> |          |         |                 |
|                   |                 | Intrusion Detection Systems     | 1        | \$4,986 | \$4,986         |
|                   |                 | System Monitoring               | 1        | \$3,615 | \$3,615         |
|                   |                 | Access Control                  | 1        | \$2,690 | \$2,690         |
|                   |                 | <b>Total:</b>                   |          |         | <b>\$11,291</b> |
| <b>Operation:</b> | <b>Telecom</b>  | <b>Level of Service: High</b>   |          |         |                 |
|                   |                 | Local Telephone                 | 7        | \$468   | \$3,276         |
|                   |                 | Data                            | 7        | \$3,588 | \$1,683         |
|                   |                 | Long Distance Telephone         | 7        | \$192   | \$1,344         |
|                   |                 | <b>Total:</b>                   |          |         | <b>\$6,303</b>  |

**Attachment B: Detailed MARS Reports for MSFC Property ID  
1045/62/346**

# Building Component List

Whitestone Research

**Building:** Propulsion Research & Development L

**Year Built:** 2005

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/346

**City:** Huntsville, AL

**Replacement Value:** \$21,781,307 **per SF:** \$198

**Building Gsft:** 110,279

| Uniformat | Asset Description | Component  | Date | Quantity    | Location      | Notes |
|-----------|-------------------|--|------|-------------|---------------|-------|
| B1010     |                   | Metal Decking  | 2005 | 1200 Sq Ft  |               |       |
| B1020     |                   | Steel Roof Access Ladder                             | 2005 | 55 Ln Ft    |               |       |
| B2010     |                   | Aluminum Louver, 1st Floor                           | 2005 | 2 Each      | Building 4209 |       |
| B2010     |                   | Aluminum Louver, 3rd Floor                           | 2005 | 9 Each      |               |       |
| B2010     |                   | Concrete Block, Exterior, 1st Floor                  | 2005 | 7620 Sq Ft  |               |       |
| B2010     |                   | Steel, Painted, Exterior, 1st Floor                  | 2005 | 33880 Sq Ft |               |       |
| B2010     |                   | Steel, Painted, Exterior, 1st Floor                  | 2005 | 3330 Sq Ft  | Building 4209 |       |
| B2020     |                   | Aluminum Fixed Window, 24 sf, 1st Floor              | 2005 | 56 Each     |               |       |
| B2020     |                   | Glass Curtain Wall                                   | 2005 | 18160 Sq Ft |               |       |
| B2030     |                   | Aluminum Frame, Fully Glazed, Exterior Door          | 2005 | 9 Each      |               |       |
| B2030     |                   | Steel 20'x20', Painted, Roll-up Door                 | 2005 | 5 Each      |               |       |
| B2030     |                   | Steel Single 12'x12', Painted, Roll-up Door          | 2005 | 3 Each      |               |       |
| B2030     |                   | Steel Single 12'x12', Painted, Roll-up Door          | 2005 | 3 Each      | Building 4209 |       |
| B2030     |                   | Steel, Exterior Door                                 | 2005 | 6 Each      | Building 4209 |       |
| B2030     |                   | Steel, Painted, Exterior Door                        | 2005 | 16 Each     |               |       |
| B2030     |                   | Steel, Painted, Exterior Double Door                 | 2005 | 5 Each      |               |       |
| B2030     |                   | Steel, Painted, Exterior Double Door                 | 2005 | 1 Each      | Building 4209 |       |
| B2030     |                   | Vault Door   | 2005 | 3 Each      |               |       |
| B3010     |                   | Built-up Roof  | 2005 | 87540 Sq Ft |               |       |
| B3010     |                   | Metal Canopy   | 2005 | 250 Sq Ft   |               |       |
| B3010     |                   | Metal Roof   | 2005 | 2700 Sq Ft  |               |       |
| C1010     |                   | Toilet Partitions, Painted Metal, Overhead Braced    | 2005 | 13 Each     |               |       |
| C1020     |                   | Aluminum, Fully Glazed, Interior Door                | 2005 | 2 Each      |               |       |
| C1020     |                   | Steel, Painted, Interior Double Door w/ Safety Glass | 2005 | 19 Each     |               |       |
| C1020     |                   | Steel, Painted, w/ Safety Glass, Interior Door       | 2005 | 28 Each     |               |       |
| C1020     |                   | Wood, Painted, Fully Glazed, Interior Door           | 2005 | 4 Each      |               |       |
| C1020     |                   | Wood, Solid Core, Painted, Interior Door             | 2005 | 23 Each     |               |       |
| C2010     |                   | Concrete, Exterior Stairs                            | 2005 | 24 Sq Ft    |               |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component                                     | Date | Quantity    | Location      | Notes |
|-----------|-------------------|---|------|-------------|---------------|-------|
| C2010     |                   | Metal, Painted, Exterior Railing              | 2005 | 184 Ln Ft   |               |       |
| C2010     |                   | Metal, Painted, Exterior Stairs               | 2005 | 480 Sq Ft   |               |       |
| C2010     |                   | Metal, Painted, Interior Railing              | 2005 | 22 Ln Ft    |               |       |
| C2010     |                   | Metal, Painted, Interior Stairs               | 2005 | 60 Sq Ft    |               |       |
| C3010     |                   | Ceramic Tile, 4"x4", Interior Wall Finish     | 2005 | 3880 Sq Ft  |               |       |
| C3010     |                   | Concrete Block, Painted, Interior Wall Finish | 2005 | 19054 Sq Ft |               |       |
| C3010     |                   | Concrete, Interior Wall Finish                | 2005 | 1830 Sq Ft  | Building 4209 |       |
| C3010     |                   | Concrete, Painted, Interior Wall Finish       | 2005 | 4700 Sq Ft  |               |       |
| C3010     |                   | Fabric, Interior Wall Finish                  | 2005 | 1000 Sq Ft  |               |       |
| C3010     |                   | Gypsum Board, Interior Wall Finish            | 2005 | 93712 Sq Ft |               |       |
| C3010     |                   | Steel, Interior Wall Finish                   | 2005 | 14175 Sq Ft |               |       |
| C3020     |                   | Carpet, Nylon 20 oz., Low Traffic             | 2005 | 10650 Sq Ft |               |       |
| C3020     |                   | Ceramic Tile Flooring                         | 2005 | 974 Sq Ft   |               |       |
| C3020     |                   | Concrete Flooring                             | 2005 | 9660 Sq Ft  |               |       |
| C3020     |                   | Concrete Flooring                             | 2005 | 2809 Sq Ft  | Building 4209 |       |
| C3020     |                   | Concrete, Painted Flooring                    | 2005 | 48145 Sq Ft |               |       |
| C3020     |                   | Vinyl Sheet Flooring                          | 2005 | 1288 Sq Ft  |               |       |
| C3020     |                   | Vinyl Tile Flooring                           | 2005 | 39562 Sq Ft |               |       |
| C3030     |                   | Acoustical Tile Ceiling                       | 2005 | 26083 Sq Ft |               |       |
| C3030     |                   | Concrete, Painted Ceiling                     | 2005 | 1711 Sq Ft  |               |       |
| C3030     |                   | Gypsum Board, Finished Ceiling                | 2005 | 7073 Sq Ft  |               |       |
| D1010     |                   | Bridge Crane, Overhead, 25 Ton                | 2005 | 2 Each      |               |       |
| D1010     |                   | Crane, Jib, Electric, 5 Ton                   | 2005 | 4 Each      |               |       |
| D1010     |                   | Hoist Electric, Overhead, Chain, 3 Ton        | 2005 | 1 Each      |               |       |
| D2010     |                   | Drinking Fountain, Refrigerated               | 2005 | 10 Each     |               |       |
| D2010     |                   | Emergency Eye Wash & Shower Station           | 2005 | 10 Each     |               |       |
| D2010     |                   | Lavatory, Vitreous China                      | 2005 | 12 Each     |               |       |
| D2010     |                   | Service Sink, Floor                           | 2005 | 3 Each      |               |       |
| D2010     |                   | Shower, Ceramic Tile                          | 2005 | 2 Each      |               |       |
| D2010     |                   | Sink, Enameled Steel                          | 2005 | 9 Each      |               |       |
| D2010     |                   | Sink, Iron, Enamel                            | 2005 | 9 Each      |               |       |
| D2010     |                   | Sink, Stainless Steel                         | 2005 | 2 Each      |               |       |
| D2010     |                   | Tankless Water Closet                         | 2005 | 13 Each     |               |       |
| D2010     |                   | Urinal, Vitreous China                        | 2005 | 6 Each      |               |       |
| D2020     |                   | Ball Valve, 4"                                | 2005 | 4 Each      |               |       |
| D2020     |                   | Circulator Pump, 1/2 HP, Cold Water           | 2005 | 1 Each      |               |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description | Component  | Date | Quantity      | Location      | Notes |
|-----------|-------------------|--|------|---------------|---------------|-------|
| D2020     |                   | Circulator Pump, 1/2 HP, Hot Water                 | 2005 | 1 Each        |               |       |
| D2020     |                   | Pipe & Fittings, 2" Copper, Cold Water             | 2005 | 0.125 K Ln Ft |               |       |
| D2020     |                   | Pipe & Fittings, 2" Copper, Hot Water              | 2005 | 0.125 K Ln Ft |               |       |
| D2020     |                   | Pipe & Fittings, 3/4" Copper, Cold Water           | 2005 | 0.75 K Ln Ft  |               |       |
| D2020     |                   | Pipe & Fittings, 3/4" Copper, Hot Water            | 2005 | 0.65 K Ln Ft  |               |       |
| D2020     |                   | Pipe & Fittings, 4" Copper, Cold Water             | 2005 | 0.1 K Ln Ft   |               |       |
| D2020     |                   | Pipe Insulation, Fiberglass, Cold Water            | 2005 | 0.8 K Ln Ft   |               |       |
| D2020     |                   | Pipe Insulation, Fiberglass, Hot Water             | 2005 | 0.8 K Ln Ft   |               |       |
| D2020     | WH-1, 2           | Water Heater, Electric, 120 Gal.                   | 2005 | 2 Each        |               |       |
| D2020     | WH-3, 4           | Water Heater, Electric, 52 Gal.                    | 2005 | 2 Each        |               |       |
| D2030     |                   | Backflow Preventer, 2"                             | 2005 | 1 Each        |               |       |
| D2030     |                   | Floor Drain  | 2005 | 34 Each       |               |       |
| D2030     |                   | Pipe & Fittings, 4" PVC                            | 2005 | 0.072 K Ln Ft |               |       |
| D2030     |                   | Pipe & Fittings, 6" PVC                            | 2005 | 0.062 K Ln Ft |               |       |
| D2040     |                   | Pipe & Fittings, 4" PVC                            | 2005 | 0.265 K Ln Ft |               |       |
| D2040     |                   | Pipe & Fittings, 6" PVC                            | 2005 | 0.198 K Ln Ft |               |       |
| D2040     |                   | Roof Drain, 4-6"                                   | 2005 | 18 Each       |               |       |
| D3020     | PHWP-1, 2         | Circulation Pump, 25 HP, Hot Water                 | 2005 | 2 Each        | Building 4209 |       |
| D3020     |                   | Expansion Tank, 100 Gal.                           | 2005 | 1 Each        |               |       |
| D3020     | B-1, 2            | Gas Boiler, 2,500 Mbh                              | 2005 | 2 Each        | Building 4209 |       |
| D3020     |                   | Metal Flue, Stainless Steel, 10"                   | 2005 | 0.2 K Ln Ft   |               |       |
| D3020     |                   | Pipe & Fittings, 1" Steel                          | 2005 | 0.25 K Ln Ft  |               |       |
| D3020     |                   | Pipe & Fittings, 10" Steel                         | 2005 | 0.1 K Ln Ft   | Building 4209 |       |
| D3020     |                   | Pipe & Fittings, 2" Copper                         | 2005 | 1 K Ln Ft     | Building 4209 |       |
| D3020     |                   | Pipe & Fittings, 3/4" Copper                       | 2005 | 0.55 K Ln Ft  |               |       |
| D3020     |                   | Pipe & Fittings, 4" Steel                          | 2005 | 0.45 K Ln Ft  |               |       |
| D3020     |                   | Pipe Insulation, Fiberglass, Heating Water/Steam   | 2005 | 1 K Ln Ft     |               |       |
| D3030     |                   | Ball Valve, 1"                                     | 2005 | 18 Each       |               |       |
| D3030     |                   | Ball Valve, 4"                                     | 2005 | 6 Each        |               |       |
| D3030     |                   | Ball Valve, 4"                                     | 2005 | 18 Each       |               |       |
| D3030     |                   | Butterfly Valve, 6"                                | 2005 | 6 Each        |               |       |
| D3030     | PCWP-1, 2         | Circulation Pump, 15 HP, Chiller & Condenser Water | 2005 | 2 Each        | Building 4209 |       |
| D3030     | CHWP-1, 2         | Circulation Pump, 50 HP, Chiller & Condenser Water | 2005 | 2 Each        |               |       |
| D3030     |                   | Flow Control Valve, Motorized, 2"                  | 2005 | 12 Each       |               |       |
| D3030     |                   | Flow Control Valve, Motorized, 4"                  | 2005 | 16 Each       |               |       |
| D3030     |                   | Flow Control Valve, Motorized, 6"                  | 2005 | 2 Each        |               |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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| Uniformat | Asset Description        | Component                                  | Date | Quantity     | Location      | Notes    |
|-----------|--------------------------|--|------|--------------|---------------|----------|
| D3030     |                          | Pipe & Fittings, 10" Steel                 | 2005 | 0.07 K Ln Ft | Building 4209 |          |
| D3030     |                          | Pipe & Fittings, 2" Steel                  | 2005 | 1.1 K Ln Ft  |               |          |
| D3030     |                          | Pipe & Fittings, 4" Steel                  | 2005 | 0.75 K Ln Ft |               |          |
| D3030     |                          | Pipe & Fittings, 6" Steel                  | 2005 | 0.55 K Ln Ft |               |          |
| D3030     |                          | Pipe & Fittings, 8" Steel                  | 2005 | 0.1 K Ln Ft  |               |          |
| D3030     |                          | Pipe Insulation, Fiberglass, Chilled Water | 2005 | 1.5 K Ln Ft  |               |          |
| D3040     | AHU-2, 6, 10, 18         | Air Handler, Multizone, 10,000 Cfm         | 2005 | 4 Each       |               |          |
| D3040     | AHU-9, 17                | Air Handler, Multizone, 15,000 Cfm         | 2005 | 2 Each       |               |          |
| D3040     | AHU-8                    | Air Handler, Multizone, 25,000 Cfm         | 2005 | 1 Each       |               |          |
| D3040     | AHU-1                    | Air Handler, Multizone, 30,000 Cfm         | 2005 | 1 Each       |               |          |
| D3040     | AHU-3, 11                | Air Handler, Multizone, 5,200 Cfm          | 2005 | 2 Each       |               |          |
| D3040     | AHU-5, 7, 19             | Air Handler, Single Zone, 10,000 Cfm       | 2005 | 3 Each       |               |          |
| D3040     | AHU-12, 20               | Air Handler, Single Zone, 2,500 Cfm        | 2005 | 2 Each       |               |          |
| D3040     | AHU-4, 13, 14, 15, 16    | Air Handler, Single Zone, 5,000 Cfm        | 2005 | 5 Each       |               |          |
| D3040     |                          | Duct Insulation, Fiberglass Blanket        | 2005 | 55000 Sq Ft  |               |          |
| D3040     |                          | Ductwork                                   | 2005 | 78000 Lbs    |               |          |
| D3040     | EF-29, 30                | Exhaust Fan, Centrifugal, 250 Cfm          | 2005 | 2 Each       |               |          |
| D3040     | EF-10, 11, 12, 25        | Exhaust Fan, Propeller, 1,000 Cfm          | 2005 | 4 Each       |               |          |
| D3040     | EF-27, 28                | Exhaust Fan, Propeller, 375 Cfm            | 2005 | 2 Each       |               |          |
| D3040     | EF-13, 14, 15, 18, 20, 2 | Exhaust Fan, Propeller, 4,700 Cfm          | 2005 | 9 Each       |               |          |
| D3040     | EF-16, 17                | Exhaust Fan, Propeller, 7,500 Cfm          | 2005 | 2 Each       |               |          |
| D3040     | EF-26                    | Exhaust Fan, Propeller, 800 Cfm            | 2005 | 1 Each       |               |          |
| D3040     | EF-3, 7                  | Exhaust Fan, Roof Mounted, 1,500 Cfm       | 2005 | 2 Each       |               |          |
| D3040     | EF-6                     | Exhaust Fan, Roof Mounted, 2,000 Cfm       | 2005 | 1 Each       |               |          |
| D3040     | EF-1, 2, 4, 9, 14        | Exhaust Fan, Roof Mounted, 400 Cfm         | 2005 | 5 Each       |               |          |
| D3040     | EF-5                     | Exhaust Fan, Roof Mounted, 800 Cfm         | 2005 | 1 Each       |               |          |
| D3040     |                          | Humidifier, Steam, Duct w/ Controls        | 2005 | 17 Each      |               | FOR AHUs |
| D3040     |                          | Variable Air Volume Box, 1,300 Cfm         | 2005 | 8 Each       |               |          |
| D3040     |                          | Variable Air Volume Box, 2,500 Cfm         | 2005 | 1 Each       |               |          |
| D3040     |                          | Variable Air Volume Box, 400 Cfm           | 2005 | 10 Each      |               |          |
| D3040     |                          | Variable Air Volume Box, 800 Cfm           | 2005 | 7 Each       |               |          |
| D3050     |                          | Radiant Heating Panel, Electric            | 2005 | 1 Each       |               |          |
| D3050     |                          | Secondary Coil, 12" x 24"                  | 2005 | 5 Each       |               |          |
| D3050     |                          | Secondary Coil, 24" x 24"                  | 2005 | 4 Each       |               |          |
| D3050     |                          | Secondary Coil, 24" x 36"                  | 2005 | 1 Each       |               |          |
| D3050     | UH-1:4                   | Unit Heater, 12 Mbh                        | 2005 | 4 Each       | Building 4209 |          |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

05-Mar-13

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| Uniformat | Asset Description     | Component   | Date | Quantity     | Location | Notes |
|-----------|-----------------------|---|------|--------------|----------|-------|
| D3050     | UH-5:11               | Unit Heater, 36 Mbh                                   | 2005 | 7 Each       |          |       |
| D3060     |                       | Direct Digital Controls, System Points                | 2005 | 549 Each     |          |       |
| D4010     |                       | Fire Alarm Control Panel                              | 2005 | 1 Each       |          |       |
| D4010     |                       | Fire Sprinkler Head                                   | 2005 | 590 Each     |          |       |
| D4010     |                       | Fire Sprinkler System                                 | 2005 | 1 Each       |          |       |
| D4010     |                       | Fire Suppression System Water Pump, 10 HP             | 2005 | 1 Each       |          |       |
| D4010     |                       | Pipe & Fittings, 2" Steel                             | 2005 | 4.6 K Ln Ft  |          |       |
| D4010     |                       | Pipe & Fittings, 2" Steel                             | 2005 | 0.95 K Ln Ft |          |       |
| D4010     |                       | Pipe & Fittings, 4" Steel                             | 2005 | 0.15 K Ln Ft |          |       |
| D4010     |                       | Valves & Components, Sprinkler System, 3"             | 2005 | 4 Each       |          |       |
| D4010     |                       | Valves & Components, Sprinkler System, 3"             | 2005 | 8 Each       |          |       |
| D4010     |                       | Valves & Components, Sprinkler System, 3"             | 2005 | 3 Each       |          |       |
| D5010     |                       | Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.           | 2005 | 2 Each       |          |       |
| D5010     |                       | Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.         | 2005 | 1 Each       |          |       |
| D5010     |                       | Disconnect Switch, 100 Amp.                           | 2005 | 8 Each       |          |       |
| D5010     |                       | Disconnect Switch, 200 Amp.                           | 2005 | 5 Each       |          |       |
| D5010     |                       | Disconnect Switch, 30 Amp.                            | 2005 | 45 Each      |          |       |
| D5010     |                       | Disconnect Switch, 400 Amp.                           | 2005 | 1 Each       |          |       |
| D5010     |                       | Disconnect Switch, 60 Amp.                            | 2005 | 29 Each      |          |       |
| D5010     | MCCA401, 402, 403, 60 | Motor Control Center w/ Main Breaker, 480 V, 600 Amp. | 2005 | 4 Each       |          |       |
| D5010     |                       | Motor Starter, <5HP, <600V                            | 2005 | 1 Each       |          |       |
| D5010     |                       | Motor Starter, 5-20 HP, <600 V                        | 2005 | 6 Each       |          |       |
| D5010     |                       | Power Panel Board, 208 Y/120 V, 100 Amp.              | 2005 | 32 Each      |          |       |
| D5010     |                       | Power Panel Board, 208 Y/120 V, 225 Amp               | 2005 | 9 Each       |          |       |
| D5010     |                       | Power Panel Board, 208 Y/120 V, 400 Amp.              | 2005 | 13 Each      |          |       |
| D5010     |                       | Power Panel Board, 480 V, 1,000 Amp.                  | 2005 | 1 Each       |          | 1200A |
| D5010     |                       | Power Panel Board, 480 V, 1,000 Amp.                  | 2005 | 3 Each       |          | 800A  |
| D5010     |                       | Power Panel Board, 480 V, 100 Amp.                    | 2005 | 9 Each       |          |       |
| D5010     |                       | Power Panel Board, 480 V, 200 Amp.                    | 2005 | 8 Each       |          | 225A  |
| D5010     |                       | Power Panel Board, 480 V, 200 Amp.                    | 2005 | 3 Each       |          |       |
| D5010     |                       | Power Panel Board, 480 V, 400 Amp.                    | 2005 | 7 Each       |          |       |
| D5010     |                       | Secondary Transformer, Dry, 15 kVA                    | 2005 | 1 Each       |          |       |
| D5010     |                       | Secondary Transformer, Dry, 225 kVA                   | 2005 | 2 Each       |          |       |
| D5010     |                       | Secondary Transformer, Dry, 30 kVA                    | 2005 | 2 Each       |          |       |
| D5010     |                       | Secondary Transformer, Dry, 300 kVA                   | 2005 | 2 Each       |          |       |
| D5010     | SBA101, 201, 301;MSB  | Switchboard, 1600 Amp.                                | 2005 | 4 Each       |          |       |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

| Uniformat | Asset Description | Component                                     | Date | Quantity      | Location      | Notes          |
|-----------|-------------------|---|------|---------------|---------------|----------------|
| D5010     | A306              | Switchboard, 1600 Amp.                        | 2005 | 1 Each        |               |                |
| D5010     |                   | Transfer Switch, Auto, 600 V, 1,600 Amp.      | 2005 | 1 Each        |               |                |
| D5010     |                   | Transfer Switch, Auto, 600 V, 150 Amp.        | 2005 | 1 Each        |               |                |
| D5010     |                   | Transient Voltage Surge Suppression Panel     | 2005 | 5 Each        |               |                |
| D5010     |                   | Variable Frequency Drive, <600 V              | 2005 | 3 Each        |               |                |
| D5020     |                   | Compact Fluorescent Lighting Fixture, 32 w    | 2005 | 23 Each       |               |                |
| D5020     |                   | Emergency Lighting Pack, 2 Light w/ Battery   | 2005 | 40 Each       |               |                |
| D5020     |                   | Exit Lighting Fixture, w/ Battery             | 2005 | 12 Each       |               |                |
| D5020     |                   | Fluorescent Lighting Fixture, T8, 2-32w       | 2005 | 269 Each      |               |                |
| D5020     |                   | Fluorescent Lighting Fixture, T8, 4-32 w      | 2005 | 529 Each      |               |                |
| D5020     |                   | High Pressure Sodium Lighting Fixture, 250 w  | 2005 | 14 Each       |               |                |
| D5020     |                   | Incandescent Lighting Fixture, Basic, 100 w   | 2005 | 10 Each       |               |                |
| D5020     |                   | LED Lighting Fixture, 100 w                   | 2005 | 8 Each        |               | Bollard Lights |
| D5020     |                   | LED Lighting Fixture, 100 w                   | 2005 | 2 Each        |               |                |
| D5020     |                   | Receptacle, 208 V, 3 phase                    | 2005 | 8 Each        |               |                |
| D5020     |                   | Receptacle, 120 V, 20 Amp.                    | 2005 | 1800 Each     |               |                |
| D5020     |                   | Wiring Device, Switch                         | 2005 | 480 Each      |               |                |
| D5030     |                   | Camera, Exterior, Closed Circuit, PTZ Color   | 2005 | 5 Each        |               |                |
| D5030     |                   | Camera, Interior, Closed Circuit, Fixed Color | 2005 | 6 Each        |               |                |
| D5030     |                   | Camera, Interior, Closed Circuit, PTZ Color   | 2005 | 14 Each       |               |                |
| D5030     |                   | Card Reader                                   | 2005 | 42 Each       |               |                |
| D5030     |                   | Electric Lock                                 | 2005 | 42 Each       |               |                |
| D5030     |                   | Fire Alarm Horn & Strobe                      | 2005 | 66 Each       |               |                |
| D5030     |                   | Fire Alarm Horn & Strobe                      | 2005 | 30 Each       |               | HORN           |
| D5030     |                   | Fire Alarm Strobe                             | 2005 | 41 Each       |               |                |
| D5030     |                   | Manual Pull Station                           | 2005 | 22 Each       |               |                |
| D5030     |                   | Motion Detector                               | 2005 | 21 Each       |               |                |
| D5030     |                   | Public Address Speaker                        | 2005 | 106 Each      |               |                |
| D5030     |                   | Smoke Detector                                | 2005 | 47 Each       |               |                |
| D5030     |                   | Smoke Detector, Duct                          | 2005 | 28 Each       |               |                |
| D5090     |                   | Generator, Diesel, 500 kw                     | 2005 | 1 Each        | Building 4209 |                |
| D5090     |                   | Grounding System                              | 2005 | 1.9 K Ln Ft   |               |                |
| D5090     |                   | Lightning Protection System                   | 2005 | 2.1 K Ln Ft   |               |                |
| D5090     |                   | Lightning Protection System                   | 2005 | 0.222 K Ln Ft | Building 4209 |                |
| E1020     |                   | Laboratory Exhaust Hood, 6'                   | 2005 | 6 Each        |               |                |

§ Indicates Component set to have PM Tasks coincide with Replacement Task.

All costs expressed in (\$) 2012.

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**Average M&R Costs**

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Whitestone Research

**Building:** Propulsion Research & Development Lab      **GSFT:** 110,279  
**Building Number:** 1045/62/346      **PRV:** \$21,781,307  
**Facility:** Marshall Space Flight Center      **Built Date:** 2005  
**City:** Huntsville, AL

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**M&R Average Annual Cost Forecasts**

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|                                   | <b>Current Year</b> | <b>5 Year</b> | <b>20 Year</b> | <b>50 Year</b> |
|-----------------------------------|---------------------|---------------|----------------|----------------|
| <b>PM &amp; Minor Repair:</b>     | \$95,443            | \$96,738      | \$90,465       | \$90,454       |
| <b>Unscheduled Maintenance:</b>   | \$59,663            | \$60,436      | \$57,646       | \$57,454       |
| <b>Renewal &amp; Replacement:</b> | \$15,178            | \$208,136     | \$292,682      | \$327,066      |
| <b>Total M&amp;R Costs:</b>       | \$170,284           | \$365,310     | \$440,793      | \$474,974      |
| <b>Per GSFT:</b>                  | \$1.54              | \$3.31        | \$4.00         | \$4.31         |
| <b>As % of PRV:</b>               | 0.78%               | 1.68%         | 2.02%          | 2.18%          |

# M&R Costs by System per Year Chart

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development Lab

**Facility:** Marshall Space Flight Center

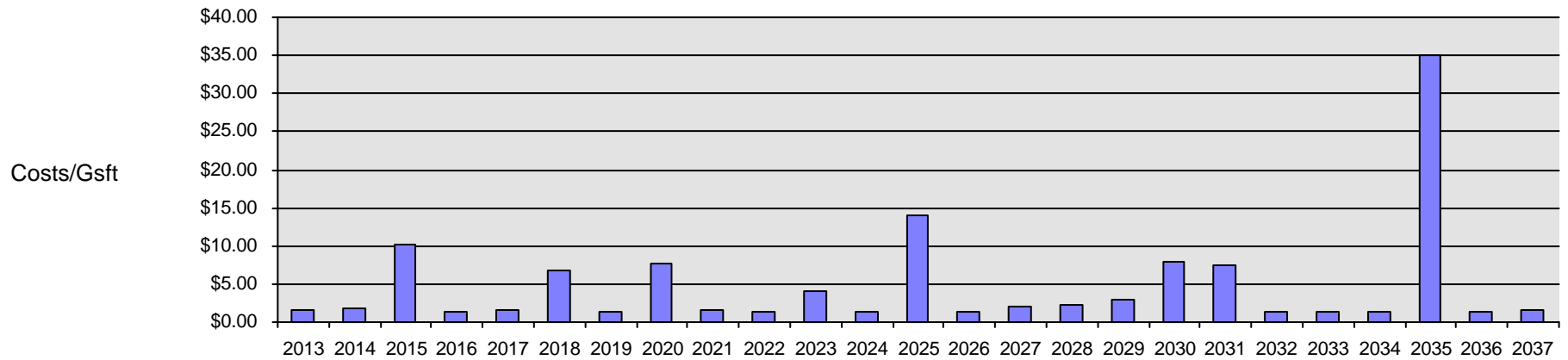
**City:** Huntsville, AL

**Building Num:** 1045/62/346

**GSFT:** 110279

Forecast Year: 2013 4 5 6 7 2018 9 0 1 2 2023 4 5 6 7 2028 9 0 1 2 2033 4 5 6 7

|                                  | 2013        | 2014        | 2015         | 2016        | 2017        | 2018        | 2019        | 2020        | 2021        | 2022        | 2023        | 2024        | 2025         | 2026        | 2027        | 2028        | 2029        | 2030        | 2031        | 2032        | 2033        | 2034        | 2035         | 2036        | 2037        |
|----------------------------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|
| A10 Foundations                  |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| A20 Basement Construction        |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| B10 S <sub>U</sub> per Structure |             |             | 0.01         |             |             |             |             | 0.01        |             |             |             |             | 0.01         |             |             |             |             |             |             |             |             |             |              | 0.20        |             |
| B20 Exterior Enclosure           | 0.01        | 0.01        | 1.05         | 0.01        | 0.02        | 0.01        | 0.01        | 0.24        | 0.01        | 0.01        | 0.01        | 0.01        | 1.06         | 0.01        | 0.01        | 0.01        | 0.02        | 0.58        | 0.01        | 0.01        | 0.01        | 0.01        | 8.49         | 0.01        | 0.01        |
| B30 Roofing                      | 0.07        | 0.07        | 0.13         | 0.07        | 0.07        | 0.07        | 0.07        | 3.82        | 0.07        | 0.07        | 0.07        | 0.07        | 0.14         | 0.07        | 0.07        | 0.07        | 0.07        | 0.12        | 0.07        | 0.07        | 0.07        | 0.07        | 8.07         | 0.07        | 0.07        |
| C10 Interior Construction        | 0.03        |             | 0.28         |             | 0.03        |             |             | 0.05        | 0.03        |             |             |             | 0.41         |             |             |             | 0.03        | 0.05        |             |             | 0.03        |             | 0.28         |             | 0.03        |
| C20 Stairs                       | 0.00        |             | 0.01         |             | 0.00        |             |             | 0.02        | 0.00        |             |             |             | 0.01         |             |             |             | 0.00        |             |             |             | 0.00        |             | 0.10         |             | 0.00        |
| C30 Interior Finishes            | 0.03        | 0.04        | 1.40         |             | 0.03        |             |             | 0.83        | 0.03        |             | 1.72        |             | 1.48         |             |             |             | 0.03        | 0.54        |             | 0.04        | 0.03        |             | 2.23         |             | 0.03        |
| D10 Conveying                    | 0.14        | 0.14        | 0.14         | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14         | 0.14        | 0.14        | 0.14        | 0.14        | 2.94        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14         | 0.14        | 0.14        |
| D20 Plumbing                     | 0.07        | 0.05        | 0.23         | 0.04        | 0.07        | 0.04        | 0.08        | 0.28        | 0.07        | 0.07        | 0.07        | 0.04        | 0.29         | 0.06        | 0.07        | 0.04        | 0.08        | 0.28        | 0.06        | 0.04        | 0.08        | 0.05        | 0.50         | 0.05        | 0.07        |
| D30 HVAC                         | 0.82        | 1.26        | 3.84         | 0.72        | 0.74        | 6.12        | 0.73        | 1.03        | 0.82        | 0.77        | 0.90        | 0.72        | 3.84         | 0.72        | 1.26        | 1.72        | 2.13        | 0.86        | 6.75        | 0.72        | 0.72        | 0.72        | 4.22         | 0.73        | 0.82        |
| D40 Fire Protection              | 0.03        | 0.03        | 0.26         | 0.03        | 0.04        | 0.03        | 0.03        | 0.11        | 0.03        | 0.03        | 0.03        | 0.03        | 0.72         | 0.03        | 0.03        | 0.03        | 0.04        | 0.04        | 0.03        | 0.03        | 0.03        | 0.03        | 0.33         | 0.03        | 0.03        |
| D50 Electrical                   | 0.34        | 0.32        | 2.93         | 0.30        | 0.35        | 0.30        | 0.34        | 0.94        | 0.34        | 0.30        | 1.15        | 0.30        | 5.96         | 0.32        | 0.34        | 0.31        | 0.35        | 2.51        | 0.34        | 0.32        | 0.34        | 0.30        | 10.32        | 0.30        | 0.34        |
| E10 E <sub>U</sub> equipment     | 0.01        | 0.01        | 0.01         | 0.01        | 0.01        | 0.01        | 0.01        | 0.17        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01         | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.17         | 0.01        | 0.01        |
| E20 Furnishings                  |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| F10 Special Construction         |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| F20 Selective Bldg Demolition    |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| G10 Site Preparation             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| G20 Site Improvements            |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| G30 Site Mechanical Utilities    |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| G40 Site Electrical Utilities    |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| G90 Other Site Construction      |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |
| <b>Total</b>                     | <b>1.54</b> | <b>1.92</b> | <b>10.27</b> | <b>1.32</b> | <b>1.50</b> | <b>6.71</b> | <b>1.40</b> | <b>7.63</b> | <b>1.54</b> | <b>1.40</b> | <b>4.10</b> | <b>1.32</b> | <b>14.06</b> | <b>1.36</b> | <b>1.93</b> | <b>2.32</b> | <b>2.90</b> | <b>7.92</b> | <b>7.41</b> | <b>1.37</b> | <b>1.47</b> | <b>1.33</b> | <b>35.04</b> | <b>1.34</b> | <b>1.54</b> |



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft.

Based on a 50-Year Forecast.

Year 1-25

# M&R Costs by System per Year Chart

**Building:** Propulsion Research & Development Lab

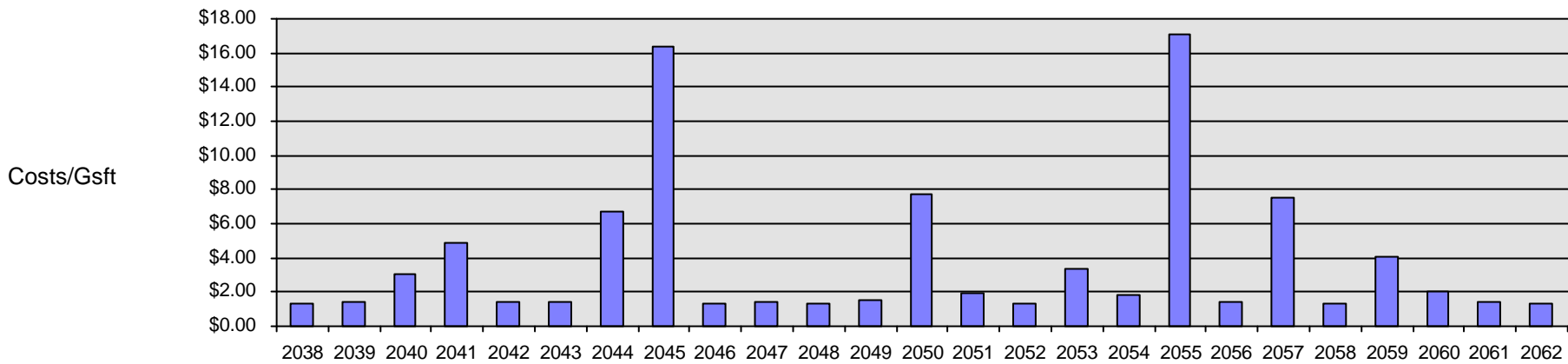
**Facility:** Marshall Space Flight Center

**City:** Huntsville, AL

**Building Num:** 1045/62/346

**GSFT:** 110279

|                               | 2038        | 9           | 0           | 1           | 2           | 2043        | 4           | 5            | 6           | 7           | 2048        | 9           | 0           | 1           | 2           | 2053        | 4           | 5            | 6           | 7           | 2058        | 9           | 0           | 1           | 2           | Total |
|-------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------|
| A10 Foundations               |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| A20 Basement Construction     |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| B10 Super Structure           |             |             |             |             |             |             |             | 0.05         |             |             |             |             |             |             |             |             |             | 0.01         |             |             |             |             | 0.01        |             |             | 0.31  |
| B20 Exterior Enclosure        | 0.01        | 0.01        | 0.74        | 0.02        | 0.01        | 0.01        | 0.01        | 0.96         | 0.01        | 0.01        | 0.01        | 0.01        | 0.34        | 0.01        | 0.01        | 0.02        | 0.01        | 1.42         | 0.01        | 0.01        | 0.01        | 0.01        | 0.29        | 0.01        | 0.01        | 15.52 |
| B30 Roofing                   | 0.07        | 0.07        | 0.12        | 0.07        | 0.07        | 0.07        | 0.07        | 0.37         | 0.07        | 0.07        | 0.07        | 0.07        | 3.82        | 0.07        | 0.07        | 0.07        | 0.07        | 0.13         | 0.07        | 0.07        | 0.07        | 0.07        | 0.12        | 0.07        | 0.07        | 19.84 |
| C10 Interior Construction     |             |             | 0.05        | 0.03        |             |             |             | 0.62         |             |             |             | 0.03        | 0.05        |             |             | 0.03        | 0.37        |              | 0.03        |             | 0.00        | 0.05        | 0.03        |             |             | 2.57  |
| C20 Stairs                    |             |             |             | 0.00        |             |             |             | 0.01         |             |             |             | 0.00        | 0.02        |             |             | 0.00        | 0.16        |              | 0.00        |             | 0.00        |             | 0.00        |             |             | 0.31  |
| C30 Interior Finishes         |             |             | 0.01        | 1.75        |             |             |             | 1.48         |             |             |             | 0.03        | 0.87        |             |             | 0.03        | 2.04        |              | 0.03        |             | 1.72        | 0.01        | 0.03        |             |             | 16.47 |
| D10 Conveying                 | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14         | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 2.94        | 0.14         | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 0.14        | 12.39 |
| D20 Plumbing                  | 0.04        | 0.11        | 0.36        | 0.05        | 0.07        | 0.05        | 0.06        | 0.38         | 0.05        | 0.06        | 0.07        | 0.05        | 0.34        | 0.06        | 0.05        | 0.05        | 0.08        | 0.39         | 0.10        | 0.05        | 0.06        | 0.05        | 0.10        | 0.07        | 0.06        | 5.58  |
| D30 HVAC                      | 0.72        | 0.78        | 1.27        | 1.59        | 0.78        | 0.78        | 6.07        | 5.48         | 0.72        | 0.73        | 0.72        | 0.82        | 0.99        | 1.26        | 0.72        | 2.57        | 1.18        | 3.98         | 0.77        | 6.84        | 0.72        | 0.91        | 0.73        | 0.73        | 0.72        | 86.29 |
| D40 Fire Protection           | 0.03        | 0.03        | 0.03        | 0.04        | 0.03        | 0.03        | 0.03        | 0.72         | 0.03        | 0.03        | 0.03        | 0.03        | 0.11        | 0.03        | 0.03        | 0.04        | 0.03        | 0.40         | 0.03        | 0.03        | 0.03        | 0.03        | 0.03        | 0.03        | 0.03        | 4.07  |
| D50 Electrical                | 0.32        | 0.34        | 0.32        | 1.15        | 0.30        | 0.34        | 0.32        | 6.14         | 0.31        | 0.35        | 0.30        | 0.34        | 0.93        | 0.34        | 0.30        | 0.35        | 0.30        | 5.24         | 0.32        | 0.34        | 0.30        | 1.15        | 0.51        | 0.34        | 0.32        | 51.19 |
| E10 Equipment                 | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01         | 0.01        | 0.01        | 0.01        | 0.01        | 0.17        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01         | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.01        | 0.82  |
| E20 Furnishings               |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| F10 Special Construction      |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| F20 Selective Bldg Demolition |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| G10 Site Preparation          |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| G20 Site Improvements         |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| G30 Site Mechanical Utilities |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| G40 Site Electrical Utilities |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| G90 Other Site Construction   |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             |             |             |              |             |             |             |             |             |             |             | 0.00  |
| <b>Total</b>                  | <b>1.34</b> | <b>1.47</b> | <b>3.05</b> | <b>4.85</b> | <b>1.41</b> | <b>1.42</b> | <b>6.70</b> | <b>16.37</b> | <b>1.34</b> | <b>1.39</b> | <b>1.35</b> | <b>1.52</b> | <b>7.77</b> | <b>1.91</b> | <b>1.34</b> | <b>3.31</b> | <b>1.82</b> | <b>17.10</b> | <b>1.45</b> | <b>7.55</b> | <b>1.35</b> | <b>4.09</b> | <b>2.00</b> | <b>1.44</b> | <b>1.35</b> |       |



Notes: A value of "0.00" means cost of more than \$.000 but less than \$.005 per gsft. All costs expressed in (\$) 2012 per gsft. Year 26-50 Based on a 50-Year Forecast.







# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4 | 5      | 6 | 7     | 2018 | 9 | 0 | 1      | 2 | 2023 | 4 | 5      | 6 | 7 | 2028 | 9 | 0 | 1 | 2 | 2033 | 4 | 5 | 6     | 7 |         |
|--|------|---|--------|---|-------|------|---|---|--------|---|------|---|--------|---|---|------|---|---|---|---|------|---|---|-------|---|---------|
| Repair Steel Single 12'x12', Painted, Roll-up Door         |      |   | 4,095  |   |       |      |   |   |        |   |      |   | 4,095  |   |   |      |   |   |   |   |      |   |   | 4,095 |   |         |
| Repair Steel, Painted, Exterior, 1st Floor (2% of Walls)   |      |   |        |   |       |      |   |   |        |   |      |   |        |   |   |      |   |   |   |   |      |   |   |       |   | 20,356  |
| Repair Aluminum Frame, Fully Glazed, Exterior Door         |      |   |        |   | 1,670 |      |   |   |        |   |      |   |        |   |   |      |   |   |   |   |      |   |   |       |   | 1,670   |
| Minor Repair, Glass Curtain Wall (2% of Walls)             |      |   | 17,779 |   |       |      |   |   | 17,779 |   |      |   | 17,779 |   |   |      |   |   |   |   |      |   |   |       |   | 17,779  |
| Maintain Aluminum Frame, Fully Glazed, Exterior Door Locks |      |   | 214    |   |       |      |   |   | 214    |   |      |   | 214    |   |   |      |   |   |   |   |      |   |   |       |   | 214     |
| Replace Glass Curtain Wall                                 |      |   |        |   |       |      |   |   |        |   |      |   |        |   |   |      |   |   |   |   |      |   |   |       |   | 832,756 |
| Refinish Aluminum Louver, 1st Floor                        |      |   | 91     |   |       |      |   |   |        |   |      |   | 91     |   |   |      |   |   |   |   |      |   |   |       |   | 91      |
| Replace Aluminum Frame, Fully Glazed, Exterior Door        |      |   |        |   |       |      |   |   |        |   |      |   |        |   |   |      |   |   |   |   |      |   |   |       |   |         |

## B30 Roofing

|  |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|
| Replace Metal Canopy                               |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 9,672   |       |
| Maintain Built-up Roof                             | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664   | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664   | 3,664 |
| Minor Replacement, Metal Roof (2% of Roof)         |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 550     |       |
| Replace Metal Roof                                 |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |
| Repair Metal Roof                                  |       |       | 591   |       |       |       |       |       | 591     |       |       |       | 591   |       |       |       |       |       |       |       |       |       |       |       |       |       | 591     |       |
| Maintain Metal Roof                                | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308     | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308     |       |
| Refinish Metal Canopy                              |       |       | 421   |       |       |       |       |       |         |       |       |       | 421   |       |       |       |       |       |       |       |       |       |       |       |       |       | 421     |       |
| Replace Membrane, Built-up Roof                    |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 878,873 |       |
| Non-Destructive Moisture Inspection, Built-up Roof |       |       | 4,944 |       |       |       |       |       | 4,944   |       |       |       | 4,944 |       |       |       |       |       |       |       |       |       |       |       |       |       | 4,944   |       |
| Repair Metal Canopy                                |       |       |       |       |       |       |       |       |         |       |       |       | 422   |       |       |       |       |       |       |       |       |       |       |       |       |       | 422     |       |
| Place New Membrane Over Existing, Built-up Roof    |       |       |       |       |       |       |       |       | 407,840 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 407,840 |       |

## C10 Interior Construction

|  |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
|--|--|--|-------|--|--|-----|--|--|-----|--|--|--|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|
| Replace Wood, Solid Core, Painted, Interior Door               |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
| Maintain Wood, Painted, Fully Glazed, Interior Door Locks      |  |  | 95    |  |  |     |  |  | 95  |  |  |  | 95    |  |  |  |  |  |  |  |  |  |  |  |  |  | 95     |
| Replace Wood, Painted, Fully Glazed, Interior Door Locks       |  |  | 1,341 |  |  |     |  |  |     |  |  |  | 1,341 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,341  |
| Replace Wood, Painted, Fully Glazed, Interior Door             |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
| Finish Replaced Wood, Painted, Fully Glazed, Interior Door     |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
| Refinish Wood, Solid Core, Painted, Interior Door              |  |  | 572   |  |  | 572 |  |  |     |  |  |  | 572   |  |  |  |  |  |  |  |  |  |  |  |  |  | 572    |
| Replace Wood, Solid Core, Painted, Interior Door Locks         |  |  | 7,711 |  |  |     |  |  |     |  |  |  | 7,711 |  |  |  |  |  |  |  |  |  |  |  |  |  | 7,711  |
| Finish Replaced Wood, Solid Core, Painted, Interior Door       |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
| Replace Toilet Partitions, Painted Metal, Overhead Braced      |  |  |       |  |  |     |  |  |     |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  | 10,992 |
| Refinish Wood, Painted, Fully Glazed, Interior Door            |  |  | 99    |  |  | 99  |  |  |     |  |  |  | 99    |  |  |  |  |  |  |  |  |  |  |  |  |  | 99     |
| Maintain Wood, Solid Core, Painted, Interior Door Locks        |  |  | 548   |  |  |     |  |  | 548 |  |  |  | 548   |  |  |  |  |  |  |  |  |  |  |  |  |  | 548    |
| Maintain Aluminum, Fully Glazed, Interior Door Locks           |  |  | 48    |  |  |     |  |  | 48  |  |  |  | 48    |  |  |  |  |  |  |  |  |  |  |  |  |  | 48     |
| Maintain Steel, Painted, w/ Safety Glass Interior Door Locks   |  |  | 667   |  |  |     |  |  | 667 |  |  |  | 667   |  |  |  |  |  |  |  |  |  |  |  |  |  | 667    |
| Refinish Steel, Painted, w/ Safety Glass Interior Door         |  |  | 697   |  |  | 697 |  |  |     |  |  |  | 697   |  |  |  |  |  |  |  |  |  |  |  |  |  | 697    |
| Replace Steel, Painted, Interior Double Door w/ Safety Glass L |  |  | 6,370 |  |  |     |  |  |     |  |  |  | 6,370 |  |  |  |  |  |  |  |  |  |  |  |  |  | 6,370  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9 | 0      | 1     | 2 | 2043 | 4 | 5      | 6 | 7 | 2048 | 9 | 0     | 1 | 2 | 2053   | 4 | 5      | 6      | 7 | 2058 | 9 | 0 | 1 | 2      |
|--|------|---|--------|-------|---|------|---|--------|---|---|------|---|-------|---|---|--------|---|--------|--------|---|------|---|---|---|--------|
| Repair Steel Single 12'x12', Painted, Roll-up Door         |      |   |        |       |   |      |   |        |   |   |      |   | 4,095 |   |   |        |   |        |        |   |      |   |   |   | 4,095  |
| Repair Steel, Painted, Exterior, 1st Floor (2% of Walls)   |      |   |        |       |   |      |   |        |   |   |      |   |       |   |   |        |   | 20,356 |        |   |      |   |   |   |        |
| Repair Aluminum Frame, Fully Glazed, Exterior Door         |      |   |        | 1,670 |   |      |   |        |   |   |      |   |       |   |   | 1,670  |   |        |        |   |      |   |   |   |        |
| Minor Repair, Glass Curtain Wall (2% of Walls)             |      |   | 17,779 |       |   |      |   | 17,779 |   |   |      |   |       |   |   | 17,779 |   |        | 17,779 |   |      |   |   |   | 17,779 |
| Maintain Aluminum Frame, Fully Glazed, Exterior Door Locks |      |   | 214    |       |   |      |   | 214    |   |   |      |   |       |   |   | 214    |   |        |        |   |      |   |   |   | 214    |
| Replace Glass Curtain Wall                                 |      |   |        |       |   |      |   |        |   |   |      |   |       |   |   |        |   |        |        |   |      |   |   |   |        |
| Refinish Aluminum Louver, 1st Floor                        |      |   |        |       |   |      |   | 91     |   |   |      |   |       |   |   |        |   | 91     |        |   |      |   |   |   |        |
| Replace Aluminum Frame, Fully Glazed, Exterior Door        |      |   |        |       |   |      |   |        |   |   |      |   |       |   |   |        |   | 12,014 |        |   |      |   |   |   |        |

## B30 Roofing

|  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Replace Metal Canopy                               |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |
| Maintain Built-up Roof                             | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664   | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 | 3,664 |
| Minor Replacement, Metal Roof (2% of Roof)         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |
| Replace Metal Roof                                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 27,474  |       |       |       |       |       |       |       |       |       |
| Repair Metal Roof                                  |       |       |       | 591   |       |       |       |       |       |       |       |       |       |       |       | 591     |       |       | 591   |       |       |       |       |       | 591   |
| Maintain Metal Roof                                | 308   | 308   | 308   | 308   | 308   | 308   | 308   |       | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308     | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   | 308   |
| Refinish Metal Canopy                              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 421     |       |       | 421   |       |       |       |       |       |       |
| Replace Membrane, Built-up Roof                    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |
| Non-Destructive Moisture Inspection, Built-up Roof |       |       | 4,944 |       |       |       |       | 4,944 |       |       |       |       |       |       |       | 4,944   |       |       | 4,944 |       |       |       |       |       | 4,944 |
| Repair Metal Canopy                                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |       |       | 422   |
| Place New Membrane Over Existing, Built-up Roof    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 407,840 |       |       |       |       |       |       |       |       |       |

## C10 Interior Construction

|  |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  |        |
|--|--|--|-----|-----|--|--|--|--|--|--|--|--|--|--|--|--------|--|--|-----|--|--|--|--|--|--------|
| Replace Wood, Solid Core, Painted, Interior Door             |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 32,450 |
| Maintain Wood, Painted, Fully Glazed, Interior Door Locks    |  |  | 95  |     |  |  |  |  |  |  |  |  |  |  |  | 95     |  |  |     |  |  |  |  |  | 95     |
| Replace Wood, Painted, Fully Glazed, Interior Door Locks     |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 1,341  |
| Replace Wood, Painted, Fully Glazed, Interior Door           |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 7,944  |
| Finish Replaced Wood, Painted, Fully Glazed, Interior Door   |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 99     |
| Refinish Wood, Solid Core, Painted, Interior Door            |  |  |     | 572 |  |  |  |  |  |  |  |  |  |  |  | 572    |  |  | 572 |  |  |  |  |  | 572    |
| Replace Wood, Solid Core, Painted, Interior Door Locks       |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 7,711  |
| Finish Replaced Wood, Solid Core, Painted, Interior Door     |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 572    |
| Replace Toilet Partitions, Painted Metal, Overhead Braced    |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  | 10,992 |  |  |     |  |  |  |  |  |        |
| Refinish Wood, Painted, Fully Glazed, Interior Door          |  |  |     | 99  |  |  |  |  |  |  |  |  |  |  |  | 99     |  |  | 99  |  |  |  |  |  | 99     |
| Maintain Wood, Solid Core, Painted, Interior Door Locks      |  |  | 548 |     |  |  |  |  |  |  |  |  |  |  |  | 548    |  |  | 548 |  |  |  |  |  | 548    |
| Maintain Aluminum, Fully Glazed, Interior Door Locks         |  |  | 48  |     |  |  |  |  |  |  |  |  |  |  |  | 48     |  |  | 48  |  |  |  |  |  | 48     |
| Maintain Steel, Painted, w/ Safety Glass Interior Door Locks |  |  | 667 |     |  |  |  |  |  |  |  |  |  |  |  | 667    |  |  | 667 |  |  |  |  |  | 667    |
| Refinish Steel, Painted, w/ Safety Glass Interior Door       |  |  |     | 697 |  |  |  |  |  |  |  |  |  |  |  | 697    |  |  | 697 |  |  |  |  |  | 697    |
| Replace Steel, Painted, Interior Double Door w/ Safety Glass |  |  |     |     |  |  |  |  |  |  |  |  |  |  |  |        |  |  |     |  |  |  |  |  | 6,370  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2013  | 4 | 5     | 6 | 7     | 2018 | 9 | 0   | 1     | 2 | 2023 | 4 | 5     | 6 | 7 | 2028 | 9     | 0 | 1 | 2 | 2033  | 4 | 5 | 6     | 7     |
|---|-------|---|-------|---|-------|------|---|-----|-------|---|------|---|-------|---|---|------|-------|---|---|---|-------|---|---|-------|-------|
| Maintain Steel, Painted, Interior Double Door w/ Safety Glass L |       |   | 727   |   |       |      |   | 727 |       |   |      |   | 727   |   |   |      | 727   |   |   |   | 727   |   |   |       |       |
| Refinish Steel, Painted, Interior Double Door w/ Safety Glass   | 1,766 |   |       |   | 1,766 |      |   |     | 1,766 |   |      |   | 1,766 |   |   |      | 1,766 |   |   |   | 1,766 |   |   |       | 1,766 |
| Replace Aluminum, Fully Glazed, Interior Door                   |       |   |       |   |       |      |   |     |       |   |      |   |       |   |   |      |       |   |   |   |       |   |   |       |       |
| Refinish Toilet Partitions, Painted Metal, Overhead Braced      | 323   |   |       |   | 323   |      |   |     | 323   |   |      |   |       |   |   |      | 323   |   |   |   | 323   |   |   |       | 323   |
| Replace Steel, Painted, w/ Safety Glass Interior Door Locks     |       |   | 9,388 |   |       |      |   |     |       |   |      |   | 9,388 |   |   |      |       |   |   |   |       |   |   | 9,388 |       |
| Replace Aluminum, Fully Glazed, Interior Door Locks             |       |   | 671   |   |       |      |   |     |       |   |      |   | 671   |   |   |      |       |   |   |   |       |   |   | 671   |       |

## C20 Stairs

|  |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
|--|----|--|-----|--|----|--|--|-------|----|--|--|--|-----|--|--|--|----|--|--|--|----|--|--|-------|----|
| Finish Replaced Metal, Painted, Interior Railing |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Repair Metal, Painted, Exterior Stairs           |    |  |     |  |    |  |  | 1,172 |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 1,172 |    |
| Replace Metal, Painted, Exterior Stairs          |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Finish Replaced Metal, Painted, Exterior Stairs  |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Refinish Metal, Painted, Interior Stairs         | 54 |  |     |  | 54 |  |  |       | 54 |  |  |  | 54  |  |  |  | 54 |  |  |  | 54 |  |  |       | 54 |
| Replace Metal, Painted, Interior Railing         |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Finish Repaired Metal, Painted, Interior Stairs  |    |  |     |  |    |  |  | 1     |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 1     |    |
| Refinish Metal, Painted, Exterior Stairs         |    |  | 436 |  |    |  |  |       |    |  |  |  | 436 |  |  |  |    |  |  |  |    |  |  | 436   |    |
| Repair Metal, Painted, Interior Stairs           |    |  |     |  |    |  |  | 147   |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 147   |    |
| Replace Concrete, Exterior Stairs                |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Finish Repaired Metal, Painted, Exterior Stairs  |    |  |     |  |    |  |  | 13    |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 13    |    |
| Finish Repaired Metal, Painted, Interior Railing |    |  |     |  |    |  |  | 1     |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 1     |    |
| Repair Concrete, Exterior Stairs                 |    |  |     |  |    |  |  | 56    |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 56    |    |
| Refinish Metal, Painted, Exterior Railing        |    |  | 185 |  |    |  |  |       |    |  |  |  | 185 |  |  |  |    |  |  |  |    |  |  |       |    |
| Repair Metal, Painted, Exterior Railing          |    |  |     |  |    |  |  | 244   |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Finish Repaired Metal, Painted, Exterior Railing |    |  |     |  |    |  |  | 4     |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  |       |    |
| Replace Metal, Painted, Exterior Railing         |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 8,807 |    |
| Finish Replaced Metal, Painted, Exterior Railing |    |  |     |  |    |  |  |       |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 167   |    |
| Refinish Metal, Painted, Interior Railing        | 19 |  |     |  | 19 |  |  |       | 19 |  |  |  | 19  |  |  |  | 19 |  |  |  | 19 |  |  |       | 19 |
| Repair Metal, Painted, Interior Railing          |    |  |     |  |    |  |  | 29    |    |  |  |  |     |  |  |  |    |  |  |  |    |  |  | 29    |    |

## C30 Interior Finishes

|  |  |  |        |  |  |  |  |       |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     |        |  |
|--|--|--|--------|--|--|--|--|-------|--|--|--|--|--------|--|--|--|--|--|--|--|--|--|-----|--------|--|
| Refinish Gypsum Board, Finished Ceiling          |  |  | 8,550  |  |  |  |  |       |  |  |  |  | 8,550  |  |  |  |  |  |  |  |  |  |     | 8,550  |  |
| Repair Vinyl Sheet Flooring (2% of Floors)       |  |  | 167    |  |  |  |  |       |  |  |  |  |        |  |  |  |  |  |  |  |  |  | 167 |        |  |
| Replace Ceramic Tile Flooring                    |  |  |        |  |  |  |  |       |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     |        |  |
| Repair Concrete Flooring (2% of Floors)          |  |  |        |  |  |  |  | 1,743 |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     | 1,743  |  |
| Refinish Concrete, Painted Flooring              |  |  | 35,436 |  |  |  |  |       |  |  |  |  | 35,436 |  |  |  |  |  |  |  |  |  |     | 35,436 |  |
| Repair Concrete, Painted Flooring (2% of Floors) |  |  |        |  |  |  |  | 6,731 |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     | 6,731  |  |
| Finish Repaired Concrete, Painted Flooring       |  |  |        |  |  |  |  | 711   |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     | 711    |  |
| Repair Ceramic Tile Flooring (2% of Floors)      |  |  |        |  |  |  |  | 369   |  |  |  |  |        |  |  |  |  |  |  |  |  |  |     | 369    |  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2038 | 9 | 0   | 1     | 2 | 2043 | 4 | 5     | 6 | 7 | 2048 | 9 | 0     | 1 | 2 | 2053 | 4     | 5     | 6 | 7 | 2058 | 9     | 0   | 1 | 2     |
|---|------|---|-----|-------|---|------|---|-------|---|---|------|---|-------|---|---|------|-------|-------|---|---|------|-------|-----|---|-------|
| Maintain Steel, Painted, Interior Double Door w/ Safety Glass |      |   | 727 |       |   |      |   | 727   |   |   |      |   | 727   |   |   |      | 727   |       |   |   |      |       | 727 |   |       |
| Refinish Steel, Painted, Interior Double Door w/ Safety Glass |      |   |     | 1,766 |   |      |   | 1,766 |   |   |      |   | 1,766 |   |   |      | 1,766 |       |   |   |      | 1,766 |     |   | 1,766 |
| Replace Aluminum, Fully Glazed, Interior Door                 |      |   |     |       |   |      |   |       |   |   |      |   |       |   |   |      |       | 4,249 |   |   |      |       |     |   |       |
| Refinish Toilet Partitions, Painted Metal, Overhead Braced    |      |   |     | 323   |   |      |   |       |   |   |      |   | 323   |   |   |      | 323   |       |   |   |      | 323   |     |   | 323   |
| Replace Steel, Painted, w/ Safety Glass Interior Door Locks   |      |   |     |       |   |      |   | 9,388 |   |   |      |   |       |   |   |      |       | 9,388 |   |   |      |       |     |   |       |
| Replace Aluminum, Fully Glazed, Interior Door Locks           |      |   |     |       |   |      |   | 671   |   |   |      |   |       |   |   |      |       |       |   |   |      |       |     |   |       |

## C20 Stairs

|  |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  |     |
|--|--|--|--|----|--|--|--|-----|-----|--|--|--|-------|--|--|--|--|--------|-----|----|-----|----|--|--|-----|
| Finish Replaced Metal, Painted, Interior Railing |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        | 19  |    |     |    |  |  |     |
| Repair Metal, Painted, Exterior Stairs           |  |  |  |    |  |  |  |     |     |  |  |  | 1,172 |  |  |  |  |        |     |    |     |    |  |  |     |
| Replace Metal, Painted, Exterior Stairs          |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  | 15,462 |     |    |     |    |  |  |     |
| Finish Replaced Metal, Painted, Exterior Stairs  |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        | 436 |    |     |    |  |  |     |
| Refinish Metal, Painted, Interior Stairs         |  |  |  | 54 |  |  |  | 54  |     |  |  |  | 54    |  |  |  |  |        |     | 54 |     |    |  |  | 54  |
| Replace Metal, Painted, Interior Railing         |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        | 611 |    |     |    |  |  |     |
| Finish Repaired Metal, Painted, Interior Stairs  |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     | 1  |     |    |  |  |     |
| Refinish Metal, Painted, Exterior Stairs         |  |  |  |    |  |  |  | 436 |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  |     |
| Repair Metal, Painted, Interior Stairs           |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    | 147 |    |  |  |     |
| Replace Concrete, Exterior Stairs                |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  | 754 |
| Finish Repaired Metal, Painted, Exterior Stairs  |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    | 13  |    |  |  |     |
| Finish Repaired Metal, Painted, Interior Railing |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     | 1  |  |  |     |
| Repair Concrete, Exterior Stairs                 |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     | 56 |  |  |     |
| Refinish Metal, Painted, Exterior Railing        |  |  |  |    |  |  |  |     | 185 |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  | 185 |
| Repair Metal, Painted, Exterior Railing          |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  | 244 |
| Finish Repaired Metal, Painted, Exterior Railing |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  | 4   |
| Replace Metal, Painted, Exterior Railing         |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  |     |
| Finish Replaced Metal, Painted, Exterior Railing |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  |     |
| Refinish Metal, Painted, Interior Railing        |  |  |  | 19 |  |  |  | 19  |     |  |  |  | 19    |  |  |  |  |        |     |    |     |    |  |  | 19  |
| Repair Metal, Painted, Interior Railing          |  |  |  |    |  |  |  |     |     |  |  |  |       |  |  |  |  |        |     |    |     |    |  |  | 29  |

## C30 Interior Finishes

|  |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |
|--|--|--|--|--|--|--|--|--------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|
| Refinish Gypsum Board, Finished Ceiling          |  |  |  |  |  |  |  | 8,550  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 8,550  |
| Repair Vinyl Sheet Flooring (2% of Floors)       |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 167    |
| Replace Ceramic Tile Flooring                    |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 12,456 |
| Repair Concrete Flooring (2% of Floors)          |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,743  |
| Refinish Concrete, Painted Flooring              |  |  |  |  |  |  |  | 35,436 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 35,436 |
| Repair Concrete, Painted Flooring (2% of Floors) |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 6,731  |
| Finish Repaired Concrete, Painted Flooring       |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 711    |
| Repair Ceramic Tile Flooring (2% of Floors)      |  |  |  |  |  |  |  |        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 369    |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2013  | 4     | 5      | 6 | 7     | 2018 | 9      | 0 | 1 | 2     | 2023    | 4 | 5      | 6     | 7 | 2028 | 9 | 0 | 1 | 2      | 2033 | 4     | 5      | 6 | 7     |
|---|-------|-------|--------|---|-------|------|--------|---|---|-------|---------|---|--------|-------|---|------|---|---|---|--------|------|-------|--------|---|-------|
| Replace Vinyl Sheet Flooring                                    |       |       |        |   |       |      |        |   |   |       | 9,469   |   |        |       |   |      |   |   |   |        |      |       |        |   |       |
| Repair Vinyl Tile Flooring (2% of Floors)                       |       | 2,604 |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 2,604  |      |       |        |   |       |
| Replace Vinyl Tile Flooring                                     |       |       |        |   |       |      |        |   |   |       | 179,188 |   |        |       |   |      |   |   |   |        |      |       |        |   |       |
| Repair Acoustic Tile Ceiling (2% of Ceiling)                    |       | 1,396 |        |   |       |      |        |   |   |       | 1,396   |   |        |       |   |      |   |   |   | 1,396  |      |       |        |   |       |
| Replace Carpet, Nylon 20 oz., Low Traffic                       |       |       |        |   |       |      | 82,030 |   |   |       |         |   |        |       |   |      |   |   |   |        |      |       | 82,030 |   |       |
| Repair Gypsum Board, Finished Ceiling (2% of Ceiling)           |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 607    |      |       |        |   |       |
| Finish Repaired Gypsum Board, Finished Ceiling                  |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 171    |      |       |        |   |       |
| Refinish Concrete, Painted Ceiling                              |       |       | 2,112  |   |       |      |        |   |   |       |         |   | 2,112  |       |   |      |   |   |   |        |      |       | 2,112  |   |       |
| Repair Concrete, Painted Ceiling (2% of Ceiling)                |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 745    |      |       |        |   |       |
| Refinish Concrete, Painted, Interior Wall Finish                |       |       | 4,349  |   |       |      |        |   |   |       |         |   | 4,349  |       |   |      |   |   |   |        |      |       | 4,349  |   |       |
| Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)         |       |       | 1,641  |   |       |      |        |   |   |       |         |   | 1,641  |       |   |      |   |   |   | 1,641  |      |       |        |   |       |
| Repair Ceramic Tile, 4"x4", Interior Wall Finish (2% of Walls)  |       |       | 833    |   |       |      |        |   |   |       |         |   | 833    |       |   |      |   |   |   |        |      |       | 833    |   |       |
| Refinish Concrete Block, Painted, Interior Wall Finish          |       |       | 17,632 |   |       |      |        |   |   |       |         |   | 17,632 |       |   |      |   |   |   |        |      |       | 17,632 |   |       |
| Repair Concrete Block, Painted, Interior Wall Finish (2% of Wal |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 3,820  |      |       |        |   |       |
| Repoint (50% surface) Concrete Block, Painted, Interior Wall Fi |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 40,364 |      |       |        |   |       |
| Finish Repaired Concrete Block, Painted, Interior Wall Finish   |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 353    |      |       |        |   |       |
| Finish Repaired Concrete, Painted Ceiling                       |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 42     |      |       |        |   |       |
| Repair Concrete, Interior Wall Finish (2% of Walls)             |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 727    |      |       |        |   |       |
| Repair Concrete, Painted, Interior Wall Finish (2% of Walls)    |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 1,868  |      |       |        |   |       |
| Finish Repaired Concrete, Painted, Interior Wall Finish         |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 87     |      |       |        |   |       |
| Repair Fabric, Interior Wall Finish (2% of Walls)               |       |       | 31     |   |       |      |        |   |   |       |         |   | 31     |       |   |      |   |   |   |        |      |       |        |   |       |
| Replace Fabric, Interior Wall Finish                            |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   |        |      |       | 1,498  |   |       |
| Refinish Gypsum Board, Interior Wall Finish                     |       |       | 84,310 |   |       |      |        |   |   |       |         |   | 84,310 |       |   |      |   |   |   |        |      |       | 84,310 |   |       |
| Repair Gypsum Board, Interior Wall Finish (2% of Walls)         |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 3,897  |      |       |        |   |       |
| Finish Repaired Gypsum Board, Interior Wall Finish              |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 1,685  |      |       |        |   |       |
| Repair Steel, Interior Wall Finish (2% of Walls)                |       |       |        |   |       |      |        |   |   |       |         |   |        |       |   |      |   |   |   | 8,725  |      |       |        |   |       |
| Clean & Seal Concrete, Interior Wall Finish                     | 2,187 |       |        |   | 2,187 |      |        |   |   | 2,187 |         |   |        | 2,187 |   |      |   |   |   | 2,187  |      | 2,187 |        |   | 2,187 |

## D10 Conveying

|   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|
| Maintain Crane, Jib, Electric, Chain, 5 Ton | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228   | 9,228 |
| Replace Crane, Jib, Electric, 5 Ton         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 80,231  |       |
| Replace Hoist Electric, Chain, 3 Ton        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 6,033   |       |
| Replace Bridge Crane, Overhead, 25 Ton      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 237,881 |       |
| Maintain Bridge Crane, Overhead, 25 Ton     | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435   | 2,435 |
| Maintain Hoist Electric, Chain, 3 Ton       | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251     | 251   |

## D20 Plumbing

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|
| Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,187 |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9 | 0 | 1       | 2 | 2043 | 4 | 5      | 6 | 7 | 2048 | 9 | 0      | 1 | 2 | 2053 | 4 | 5 | 6      | 7 | 2058 | 9 | 0 | 1 | 2     |         |
|--|------|---|---|---------|---|------|---|--------|---|---|------|---|--------|---|---|------|---|---|--------|---|------|---|---|---|-------|---------|
| Replace Vinyl Sheet Flooring                                   |      |   |   | 9,469   |   |      |   |        |   |   |      |   |        |   |   |      |   |   |        |   |      |   |   |   | 9,469 |         |
| Repair Vinyl Tile Flooring (2% of Floors)                      |      |   |   |         |   |      |   |        |   |   |      |   | 2,604  |   |   |      |   |   |        |   |      |   |   |   |       | 2,604   |
| Replace Vinyl Tile Flooring                                    |      |   |   | 179,188 |   |      |   |        |   |   |      |   |        |   |   |      |   |   |        |   |      |   |   |   |       | 179,188 |
| Repair Acoustic Tile Ceiling (2% of Ceiling)                   |      |   |   | 1,396   |   |      |   |        |   |   |      |   | 1,396  |   |   |      |   |   |        |   |      |   |   |   |       | 1,396   |
| Replace Carpet, Nylon 20 oz., Low Traffic                      |      |   |   |         |   |      |   |        |   |   |      |   | 82,030 |   |   |      |   |   |        |   |      |   |   |   |       | 82,030  |
| Repair Gypsum Board, Finished Ceiling (2% of Ceiling)          |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 607    |   |      |   |   |   |       | 607     |
| Finish Repaired Gypsum Board, Finished Ceiling                 |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 171    |   |      |   |   |   |       | 171     |
| Refinish Concrete, Painted Ceiling                             |      |   |   |         |   |      |   | 2,112  |   |   |      |   |        |   |   |      |   |   | 2,112  |   |      |   |   |   |       | 2,112   |
| Repair Concrete, Painted Ceiling (2% of Ceiling)               |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 745    |   |      |   |   |   |       | 745     |
| Refinish Concrete, Painted, Interior Wall Finish               |      |   |   |         |   |      |   | 4,349  |   |   |      |   |        |   |   |      |   |   | 4,349  |   |      |   |   |   |       | 4,349   |
| Repair Carpet, Nylon 20 oz., Low Traffic (2% of Carpet)        |      |   |   | 1,641   |   |      |   | 1,641  |   |   |      |   |        |   |   |      |   |   | 1,641  |   |      |   |   |   |       | 1,641   |
| Repair Ceramic Tile, 4"x4", Interior Wall Finish (2% of Walls) |      |   |   |         |   |      |   | 833    |   |   |      |   |        |   |   |      |   |   | 833    |   |      |   |   |   |       | 833     |
| Refinish Concrete Block, Painted, Interior Wall Finish         |      |   |   |         |   |      |   | 17,632 |   |   |      |   |        |   |   |      |   |   | 17,632 |   |      |   |   |   |       | 17,632  |
| Repair Concrete Block, Painted, Interior Wall Finish (2% of W  |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 3,820  |   |      |   |   |   |       | 3,820   |
| Repoint (50% surface) Concrete Block, Painted, Interior Wall   |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 40,364 |   |      |   |   |   |       | 40,364  |
| Finish Repaired Concrete Block, Painted, Interior Wall Finish  |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 353    |   |      |   |   |   |       | 353     |
| Finish Repaired Concrete, Painted Ceiling                      |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 42     |   |      |   |   |   |       | 42      |
| Repair Concrete, Interior Wall Finish (2% of Walls)            |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 727    |   |      |   |   |   |       | 727     |
| Repair Concrete, Painted, Interior Wall Finish (2% of Walls)   |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 1,868  |   |      |   |   |   |       | 1,868   |
| Finish Repaired Concrete, Painted, Interior Wall Finish        |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 87     |   |      |   |   |   |       | 87      |
| Repair Fabric, Interior Wall Finish (2% of Walls)              |      |   |   |         |   |      |   | 31     |   |   |      |   |        |   |   |      |   |   | 31     |   |      |   |   |   |       | 31      |
| Replace Fabric, Interior Wall Finish                           |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   |        |   |      |   |   |   |       |         |
| Refinish Gypsum Board, Interior Wall Finish                    |      |   |   |         |   |      |   | 84,310 |   |   |      |   |        |   |   |      |   |   | 84,310 |   |      |   |   |   |       | 84,310  |
| Repair Gypsum Board, Interior Wall Finish (2% of Walls)        |      |   |   |         |   |      |   | 3,897  |   |   |      |   |        |   |   |      |   |   |        |   |      |   |   |   |       | 3,897   |
| Finish Repaired Gypsum Board, Interior Wall Finish             |      |   |   |         |   |      |   | 1,685  |   |   |      |   |        |   |   |      |   |   |        |   |      |   |   |   |       | 1,685   |
| Repair Steel, Interior Wall Finish (2% of Walls)               |      |   |   |         |   |      |   |        |   |   |      |   |        |   |   |      |   |   | 8,725  |   |      |   |   |   |       | 8,725   |
| Clean & Seal Concrete, Interior Wall Finish                    |      |   |   | 2,187   |   |      |   | 2,187  |   |   |      |   | 2,187  |   |   |      |   |   | 2,187  |   |      |   |   |   |       | 2,187   |

## D10 Conveying

|   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |         |       |       |       |       |       |       |         |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|---------|
| Maintain Crane, Jib, Electric, Chain, 5 Ton | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228   | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228 | 9,228   |
| Replace Crane, Jib, Electric, 5 Ton         |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 80,231  |       |       |       |       |       |       | 80,231  |
| Replace Hoist Electric, Chain, 3 Ton        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 6,033   |       |       |       |       |       |       | 6,033   |
| Replace Bridge Crane, Overhead, 25 Ton      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 237,881 |       |       |       |       |       |       | 237,881 |
| Maintain Bridge Crane, Overhead, 25 Ton     | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435   | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435 | 2,435   |
| Maintain Hoist Electric, Chain, 3 Ton       | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251   | 251     | 251   | 251   | 251   | 251   | 251   | 251   | 251     |

## D20 Plumbing

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |  |  |  |  |  |  |       |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|--|--|--|--|--|--|-------|
| Replace Pipe & Fittings, 2" Copper, Cold Water (20% of Pipe) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,187 |  |  |  |  |  |  | 1,187 |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|--|--|--|--|--|--|-------|

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2013 | 4   | 5     | 6   | 7   | 2018 | 9   | 0      | 1   | 2   | 2023 | 4   | 5     | 6   | 7   | 2028 | 9   | 0   | 1   | 2   | 2033 | 4   | 5   | 6   | 7      |
|---|------|-----|-------|-----|-----|------|-----|--------|-----|-----|------|-----|-------|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|--------|
| Replace Pipe Insulation, Fiberglass, Hot Water (20% of Insulati |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 672    |
| Re-tape Pipe Insulation, Fiberglass, Hot Water                  |      |     | 221   |     |     |      |     | 221    |     |     |      |     | 221   |     |     |      |     |     |     |     |      |     |     |     | 221    |
| Replace Pipe Insulation, Fiberglass, Cold Water (20% of Insula  |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 672    |
| Re-tape Pipe Insulation, Fiberglass, Cold Water                 |      |     | 221   |     |     |      |     | 221    |     |     |      |     | 221   |     |     |      |     |     |     |     |      |     |     |     | 221    |
| Replace Pipe & Fittings, 4" Copper, Cold Water (20% of Pipe)    |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 2,810  |
| Replace 10' Section, Pipe & Fittings, 4" Copper, Cold Water     |      |     |       |     |     |      |     |        |     |     |      |     |       | 140 |     |      |     |     |     |     |      |     |     |     |        |
| Resolder Joint, Pipe & Fittings, 4" Copper, Cold Water          |      |     | 38    |     |     |      |     |        |     |     |      |     | 38    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 2" Copper, Hot Water (20% of Pipe)     |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 1,187  |
| Resolder Joint, Pipe & Fittings, 2" Copper, Hot Water           |      |     | 46    |     |     |      |     |        |     |     |      |     | 46    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace 10' Section, Pipe & Fittings, 6" DWV PVC                |      |     | 29    |     |     |      |     |        |     |     |      |     | 29    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water     |      |     |       |     |     |      |     |        |     |     |      |     |       | 59  |     |      |     |     |     |     |      |     |     |     |        |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water   |      |     |       |     |     |      |     |        |     |     |      |     |       | 152 |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe)   |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 2,633  |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water         |      |     | 243   |     |     |      |     |        |     |     |      |     | 243   |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pipe)  |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 3,038  |
| Check Operation, Water Heater, Electric, 52 Gal.                |      | 42  |       |     | 42  |      |     |        |     |     | 42   |     |       | 42  |     |      | 42  |     |     |     | 42   |     |     |     |        |
| Replace 10' Section, Pipe & Fittings, 2" Copper, Hot Water      |      |     |       |     |     |      |     |        |     |     |      |     |       | 59  |     |      |     |     |     |     |      |     |     |     |        |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water        |      |     | 281   |     |     |      |     |        |     |     |      |     | 281   |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Roof Drain, 4-6"  |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     |        |
| Maintain Roof Drain, 4-6"                                       | 455  | 455 | 455   | 455 | 455 | 455  | 455 | 455    | 455 | 455 | 455  | 455 | 455   | 455 | 455 | 455  | 455 | 455 | 455 | 455 | 455  | 455 | 455 | 455 | 455    |
| Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)               |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 1,718  |
| Replace 10' Section, Pipe & Fittings, 6" DWV PVC                |      |     | 92    |     |     |      |     |        |     |     |      |     | 92    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)               |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 1,761  |
| Replace 10' Section, Pipe & Fittings, 4" DWV PVC                |      |     | 93    |     |     |      |     |        |     |     |      |     | 93    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)               |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 538    |
| Replace 10' Section, Pipe & Fittings, 4" DWV PVC                |      |     | 25    |     |     |      |     |        |     |     |      |     | 25    |     |     |      |     |     |     |     |      |     |     |     |        |
| Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)               |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 478    |
| Drain & Flush Water Heater, Electric, 52 Gal.                   |      |     |       |     |     |      |     | 504    |     |     |      |     |       |     |     | 504  |     |     |     |     |      |     |     |     | 504    |
| Replace Floor Drain   |      |     |       |     |     |      |     |        |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     |        |
| Maintain Floor Drain  | 836  | 836 | 836   | 836 | 836 | 836  | 836 | 836    | 836 | 836 | 836  | 836 | 836   | 836 | 836 | 836  | 836 | 836 | 836 | 836 | 836  | 836 | 836 | 836 | 836    |
| Replace Backflow Preventer, 2"                                  |      |     | 1,903 |     |     |      |     |        |     |     |      |     | 1,903 |     |     |      |     |     |     |     |      |     |     |     | 1,903  |
| Maintain Backflow Preventer, 2"                                 | 113  | 113 |       | 113 | 113 | 113  | 113 | 113    | 113 | 113 | 113  | 113 |       | 113 | 113 | 113  | 113 | 113 | 113 | 113 | 113  | 113 | 113 | 113 | 113    |
| Replace Water Heater, Electric, 120 Gal.                        |      |     |       |     |     |      |     | 20,903 |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 20,903 |
| Drain & Flush Water Heater, Electric, 120 Gal.                  |      |     |       |     |     |      |     | 504    |     |     |      |     |       |     |     | 504  |     |     |     |     |      |     |     |     | 504    |
| Check Operation, Water Heater, Electric, 120 Gal.               |      | 42  |       | 42  |     |      |     |        |     |     | 42   |     |       | 42  |     |      | 42  |     |     |     | 42   |     |     |     |        |
| Replace Water Heater, Electric, 52 Gal.                         |      |     |       |     |     |      |     | 3,619  |     |     |      |     |       |     |     |      |     |     |     |     |      |     |     |     | 3,619  |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water    |      |     |       |     |     |      |     |        |     |     |      |     |       | 132 |     |      |     |     |     |     |      |     |     |     |        |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2038 | 9   | 0   | 1   | 2   | 2043 | 4   | 5      | 6   | 7   | 2048 | 9   | 0   | 1   | 2   | 2053 | 4   | 5      | 6   | 7   | 2058 | 9   | 0   | 1   | 2   |  |
|---|------|-----|-----|-----|-----|------|-----|--------|-----|-----|------|-----|-----|-----|-----|------|-----|--------|-----|-----|------|-----|-----|-----|-----|--|
| Replace Pipe Insulation, Fiberglass, Hot Water (20% of Insula |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 672    |     |     |      |     |     |     |     |  |
| Re-tape Pipe Insulation, Fiberglass, Hot Water                |      |     | 221 |     |     |      |     | 221    |     |     |      |     | 221 |     |     |      |     |        |     |     |      |     | 221 |     |     |  |
| Replace Pipe Insulation, Fiberglass, Cold Water (20% of Insul |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 672    |     |     |      |     |     |     |     |  |
| Re-tape Pipe Insulation, Fiberglass, Cold Water               |      |     | 221 |     |     |      |     | 221    |     |     |      |     | 221 |     |     |      |     |        |     |     |      |     | 221 |     |     |  |
| Replace Pipe & Fittings, 4" Copper, Cold Water (20% of Pipe)  |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 2,810  |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 4" Copper, Cold Water   |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 140    |     |     |      |     |     |     |     |  |
| Resolder Joint, Pipe & Fittings, 4" Copper, Cold Water        |      |     | 38  |     |     |      |     |        |     |     |      |     | 38  |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 2" Copper, Hot Water (20% of Pipe)   |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 1,187  |     |     |      |     |     |     |     |  |
| Resolder Joint, Pipe & Fittings, 2" Copper, Hot Water         |      |     | 46  |     |     |      |     |        |     |     |      |     | 46  |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 6" DWV PVC              |      |     |     |     |     |      |     |        | 29  |     |      |     |     |     |     |      |     | 29     |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 2" Copper, Cold Water   |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 59     |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Cold Water |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 152    |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 3/4" Copper, Hot Water (20% of Pipe  |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 2,633  |     |     |      |     |     |     |     |  |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Hot Water       |      |     | 243 |     |     |      |     |        |     |     |      |     | 243 |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 3/4" Copper, Cold Water (20% of Pip  |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 3,038  |     |     |      |     |     |     |     |  |
| Check Operation, Water Heater, Electric, 52 Gal.              | 42   |     |     | 42  |     |      | 42  |        |     | 42  |      |     |     |     |     | 42   |     |        | 42  |     |      | 42  |     |     | 42  |  |
| Replace 10' Section, Pipe & Fittings, 2" Copper, Hot Water    |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 59     |     |     |      |     |     |     |     |  |
| Resolder Joint, Pipe & Fittings, 3/4" Copper, Cold Water      |      |     | 281 |     |     |      |     |        |     |     |      |     | 281 |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Replace Roof Drain, 4-6"                                      |      |     |     |     |     |      |     | 9,099  |     |     |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Maintain Roof Drain, 4-6"                                     | 455  | 455 | 455 | 455 | 455 | 455  | 455 |        | 455 | 455 | 455  | 455 | 455 | 455 | 455 | 455  | 455 | 455    | 455 | 455 | 455  | 455 | 455 | 455 | 455 |  |
| Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)             |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 92     |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 6" DWV PVC              |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 92     |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)             |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 93     |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 4" DWV PVC              |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 93     |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 6" DWV PVC (20% of Pipe)             |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 25     |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 4" DWV PVC              |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 25     |     |     |      |     |     |     |     |  |
| Replace Pipe & Fittings, 4" DWV PVC (20% of Pipe)             |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Drain & Flush Water Heater, Electric, 52 Gal.                 |      |     |     |     | 504 |      |     |        |     |     |      |     | 504 |     |     |      |     |        |     |     | 504  |     |     |     |     |  |
| Replace Floor Drain   |      |     |     |     |     |      |     | 10,308 |     |     |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |  |
| Maintain Floor Drain  | 836  | 836 | 836 | 836 | 836 | 836  | 836 |        | 836 | 836 | 836  | 836 | 836 | 836 | 836 | 836  | 836 | 836    | 836 | 836 | 836  | 836 | 836 | 836 | 836 |  |
| Replace Backflow Preventer, 2"                                |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 1,903  |     |     |      |     |     |     |     |  |
| Maintain Backflow Preventer, 2"                               | 113  | 113 | 113 | 113 | 113 | 113  | 113 |        | 113 | 113 | 113  | 113 | 113 | 113 | 113 | 113  | 113 | 113    | 113 | 113 | 113  | 113 | 113 | 113 | 113 |  |
| Replace Water Heater, Electric, 120 Gal.                      |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 20,903 |     |     |      |     |     |     |     |  |
| Drain & Flush Water Heater, Electric, 120 Gal.                |      |     |     |     | 504 |      |     |        |     |     |      |     | 504 |     |     |      |     |        |     |     | 504  |     |     |     |     |  |
| Check Operation, Water Heater, Electric, 120 Gal.             | 42   |     |     | 42  |     |      | 42  |        |     | 42  |      |     |     |     |     | 42   |     |        | 42  |     |      | 42  |     |     | 42  |  |
| Replace Water Heater, Electric, 52 Gal.                       |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 3,619  |     |     |      |     |     |     |     |  |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper, Hot Water  |      |     |     |     |     |      |     |        |     |     |      |     |     |     |     |      |     | 132    |     |     |      |     |     |     |     |  |



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2013 | 4   | 5      | 6   | 7   | 2018 | 9   | 0   | 1   | 2  | 2023  | 4   | 5      | 6   | 7   | 2028 | 9   | 0      | 1   | 2   | 2033 | 4   | 5   | 6      | 7   |
|---|------|-----|--------|-----|-----|------|-----|-----|-----|----|-------|-----|--------|-----|-----|------|-----|--------|-----|-----|------|-----|-----|--------|-----|
| Replace Lavatory, Vitreous China                            |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Valve Set, Sink, Enameled Steel                     |      |     | 1,507  |     |     |      |     |     |     |    |       |     | 1,507  |     |     |      |     |        |     |     |      |     |     | 1,507  |     |
| Repair Strainer, Sink, Floor                                | 178  |     |        |     |     |      |     |     | 178 |    |       |     |        |     |     |      | 178 |        |     |     |      |     |     |        | 178 |
| Repair Strainer, Sink, Enameled Steel                       | 316  |     |        |     |     |      |     |     | 316 |    |       |     |        |     |     |      | 316 |        |     |     |      |     |     |        | 316 |
| Replace Faucet Washer & Clean Trap, Sink, Floor             | 36   |     | 36     |     | 36  |      | 36  |     | 36  |    | 36    |     | 36     |     | 36  |      | 36  |        | 36  |     | 36   |     | 36  |        | 36  |
| Replace Faucet Washer & Clean Trap, Sink, Enameled Steel    | 191  |     | 191    |     | 191 |      | 191 |     | 191 |    | 191   |     | 191    |     | 191 |      | 191 |        | 191 |     | 191  |     | 191 |        | 191 |
| Replace Shower, Ceramic Tile                                |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     | 2,408  |     |
| Replace Valve Set, Shower, Ceramic Tile                     |      |     | 327    |     |     |      |     |     |     |    |       |     | 327    |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Sink, Enameled Steel                                |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Faucet Washer & Clean Shower Head, Ceramic Tile     | 42   |     | 42     |     | 42  |      | 42  |     | 42  |    | 42    |     | 42     |     | 42  |      | 42  |        | 42  |     | 42   |     | 42  |        | 42  |
| Inspect & Clean Emergency Eye Wash & Shower Station         |      | 416 |        |     | 416 |      |     | 416 |     |    | 416   |     |        | 416 |     |      | 416 |        |     |     | 416  |     |     | 416    |     |
| Replace Valve Set, Lavatory, Vitreous China                 |      |     | 1,588  |     |     |      |     |     |     |    |       |     | 1,588  |     |     |      |     |        |     |     |      |     |     | 1,588  |     |
| Replace Washer & Spud Connection, Lavatory, Vitreous China  |      |     |        |     |     |      | 467 |     |     |    |       |     | 467    |     |     |      |     |        |     |     | 467  |     |     |        |     |
| Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chin | 256  |     | 256    |     | 256 |      | 256 |     | 256 |    | 256   |     | 256    |     | 256 |      | 256 |        | 256 |     | 256  |     | 256 |        | 256 |
| Replace Emergency Eye Wash & Shower Station                 |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     | 13,622 |     |     |      |     |     |        |     |
| Repack Valve Glands, Emergency Eye Wash & Shower Station    |      |     | 509    |     |     |      |     |     |     |    |       |     | 509    |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Circulator Pump, 1/2 HP, Hot Water                  |      |     |        |     |     |      |     |     |     |    |       |     | 3,062  |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Drinking Fountain, Refrigerated                     |      |     | 10,119 |     |     |      |     |     |     |    |       |     | 10,119 |     |     |      |     |        |     |     |      |     |     | 10,119 |     |
| Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water      |      |     | 46     |     |     |      |     |     |     |    |       |     | 46     |     |     |      |     |        |     |     |      |     |     |        |     |
| Reseal Shower, Ceramic Tile                                 |      |     | 84     |     |     |      |     | 84  |     |    |       |     | 84     |     |     |      |     |        | 84  |     |      |     |     |        |     |
| Inspect & Lubricate Circulator Pump, 1/2 HP, Hot Water      | 25   | 25  | 25     | 25  | 25  | 25   | 25  | 25  | 25  | 25 | 25    | 25  | 25     | 25  | 25  | 25   | 25  | 25     | 25  | 25  | 25   | 25  | 25  | 25     | 25  |
| Replace Coolant & Adjust Drinking Fountain, Refrigerated    | 261  |     |        |     | 261 |      | 261 |     | 261 |    | 261   |     |        |     | 261 |      | 261 |        | 261 |     | 261  |     |     |        | 261 |
| Replace Faucet Washer & Clean Trap, Sink, Iron, Enamel      | 191  |     | 191    |     | 191 |      | 191 |     | 191 |    | 191   |     | 191    |     | 191 |      | 191 |        | 191 |     | 191  |     | 191 |        | 191 |
| Overhaul Circulator Pump, 1/2 HP, Hot Water                 |      |     | 50     |     |     |      |     | 50  |     |    |       |     |        |     |     |      |     | 50     |     |     |      |     |     | 50     |     |
| Replace Circulator Pump, 1/2 HP, Cold Water                 |      |     |        |     |     |      |     |     |     |    |       |     | 3,062  |     |     |      |     |        |     |     |      |     |     |        |     |
| Overhaul Circulator Pump, 1/2 HP, Cold Water                |      |     | 50     |     |     |      |     | 50  |     |    |       |     |        |     |     |      |     | 50     |     |     |      |     |     | 50     |     |
| Inspect & Lubricate Circulator Pump, 1/2 HP, Cold Water     | 25   | 25  | 25     | 25  | 25  | 25   | 25  | 25  | 25  | 25 | 25    | 25  | 25     | 25  | 25  | 25   | 25  | 25     | 25  | 25  | 25   | 25  | 25  | 25     | 25  |
| Replace Ball Valve, 4"                                      |      |     |        |     |     |      |     |     |     |    | 4,105 |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Lubricate, Repack Gland, Ball Valve, 4"                     | 120  | 120 | 120    | 120 | 120 | 120  | 120 | 120 | 120 |    | 120   | 120 | 120    | 120 | 120 | 120  | 120 | 120    | 120 | 120 | 120  | 120 | 120 | 120    | 120 |
| Replace Urinal, Vitreous China                              |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Sink, Iron, Enamel                                  |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Tankless Water Closet                               |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Flush Valve, Tankless Water Closet                  |      |     | 271    |     |     |      |     |     |     |    |       |     | 271    |     |     |      |     |        |     |     |      |     |     | 271    |     |
| Replace Sink, Stainless Steel                               |      |     |        |     |     |      |     |     |     |    |       |     |        |     |     |      |     |        |     |     |      |     |     |        |     |
| Replace Valve Set, Sink, Stainless Steel                    |      |     | 265    |     |     |      |     |     |     |    |       |     | 265    |     |     |      |     |        |     |     |      |     |     | 265    |     |
| Repair Strainer, Sink, Stainless Steel                      | 123  |     |        |     |     |      |     |     | 123 |    |       |     |        |     |     |      | 123 |        |     |     |      |     |     |        | 123 |
| Replace Faucet Washer & Clean Trap, Sink, Stainless Steel   | 42   |     | 42     |     | 42  |      | 42  |     | 42  |    | 42    |     | 42     |     | 42  |      | 42  |        | 42  |     | 42   |     | 42  |        | 42  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9   | 0     | 1   | 2   | 2043 | 4   | 5   | 6      | 7   | 2048 | 9   | 0     | 1   | 2   | 2053 | 4   | 5   | 6      | 7   | 2058 | 9   | 0     | 1   | 2   |
|--|------|-----|-------|-----|-----|------|-----|-----|--------|-----|------|-----|-------|-----|-----|------|-----|-----|--------|-----|------|-----|-------|-----|-----|
| Replace Lavatory, Vitreous China                           |      |     | 5,575 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Valve Set, Sink, Enameled Steel                    |      |     |       |     |     |      |     |     |        |     |      |     | 1,507 |     |     |      |     |     |        |     |      |     | 1,507 |     |     |
| Repair Strainer, Sink, Floor                               |      |     |       |     |     |      |     |     |        |     |      | 178 |       |     |     |      |     |     |        |     |      | 178 |       |     |     |
| Repair Strainer, Sink, Enameled Steel                      |      |     |       |     |     |      |     |     |        |     |      | 316 |       |     |     |      |     |     |        |     |      | 316 |       |     |     |
| Replace Faucet Washer & Clean Trap, Sink, Floor            |      | 36  |       |     | 36  |      | 36  |     | 36     |     | 36   |     | 36    |     | 36  |      | 36  |     | 36     |     | 36   |     | 36    |     | 36  |
| Replace Faucet Washer & Clean Trap, Sink, Enameled Steel   |      | 191 |       |     | 191 |      | 191 |     | 191    |     | 191  |     | 191   |     | 191 |      | 191 |     | 191    |     | 191  |     | 191   |     | 191 |
| Replace Shower, Ceramic Tile                               |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Valve Set, Shower, Ceramic Tile                    |      |     |       |     |     |      |     |     | 327    |     |      |     |       |     |     |      |     |     | 327    |     |      |     |       |     |     |
| Replace Sink, Enameled Steel                               |      |     | 7,635 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Faucet Washer & Clean Shower Head, Ceramic Tile    |      | 42  |       | 42  |     | 42   |     | 42  |        | 42  |      | 42  |       | 42  |     | 42   |     | 42  |        | 42  |      | 42  |       | 42  |     |
| Inspect & Clean Emergency Eye Wash & Shower Station        |      | 416 |       |     | 416 |      | 416 |     | 416    |     | 416  |     | 416   |     | 416 |      | 416 |     | 416    |     | 416  |     | 416   |     | 416 |
| Replace Valve Set, Lavatory, Vitreous China                |      |     |       |     |     |      |     |     |        |     |      |     | 1,588 |     |     |      |     |     |        |     |      |     | 1,588 |     |     |
| Replace Washer & Spud Connection, Lavatory, Vitreous Chin  |      |     |       |     |     |      |     |     |        | 467 |      |     |       |     |     |      | 467 |     |        |     |      |     |       | 467 |     |
| Replace Faucet Washer & Clean Trap, Lavatory, Vitreous Chi |      | 256 |       |     | 256 |      | 256 |     | 256    |     | 256  |     | 256   |     | 256 |      | 256 |     | 256    |     | 256  |     | 256   |     | 256 |
| Replace Emergency Eye Wash & Shower Station                |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     | 13,622 |     |      |     |       |     |     |
| Repack Valve Glands, Emergency Eye Wash & Shower Statio    |      |     | 509   |     |     |      |     |     |        |     |      |     | 509   |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Circulator Pump, 1/2 HP, Hot Water                 |      |     |       |     |     |      |     |     | 3,062  |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Drinking Fountain, Refrigerated                    |      |     |       |     |     |      |     |     | 10,119 |     |      |     |       |     |     |      |     |     | 10,119 |     |      |     |       |     |     |
| Resolder Joint, Pipe & Fittings, 2" Copper, Cold Water     |      |     | 46    |     |     |      |     |     |        |     |      |     | 46    |     |     |      |     |     |        |     |      |     |       |     |     |
| Reseal Shower, Ceramic Tile                                |      |     | 84    |     |     |      |     |     | 84     |     |      |     | 84    |     |     |      |     |     | 84     |     |      |     |       | 84  |     |
| Inspect & Lubricate Circulator Pump, 1/2 HP, Hot Water     | 25   | 25  | 25    | 25  | 25  | 25   | 25  | 25  | 25     | 25  | 25   | 25  | 25    | 25  | 25  | 25   | 25  | 25  | 25     | 25  | 25   | 25  | 25    | 25  | 25  |
| Replace Coolant & Adjust Drinking Fountain, Refrigerated   |      | 261 |       |     | 261 |      | 261 |     | 261    |     | 261  |     | 261   |     | 261 |      | 261 |     | 261    |     | 261  |     | 261   |     | 261 |
| Replace Faucet Washer & Clean Trap, Sink, Iron, Enamel     |      | 191 |       |     | 191 |      | 191 |     | 191    |     | 191  |     | 191   |     | 191 |      | 191 |     | 191    |     | 191  |     | 191   |     | 191 |
| Overhaul Circulator Pump, 1/2 HP, Hot Water                |      |     | 50    |     |     |      |     |     |        |     |      |     | 50    |     |     |      |     | 50  |        |     |      |     | 50    |     |     |
| Replace Circulator Pump, 1/2 HP, Cold Water                |      |     |       |     |     |      |     |     | 3,062  |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Overhaul Circulator Pump, 1/2 HP, Cold Water               |      |     | 50    |     |     |      |     |     |        |     |      |     | 50    |     |     |      |     | 50  |        |     |      |     | 50    |     |     |
| Inspect & Lubricate Circulator Pump, 1/2 HP, Cold Water    | 25   | 25  | 25    | 25  | 25  | 25   | 25  | 25  | 25     | 25  | 25   | 25  | 25    | 25  | 25  | 25   | 25  | 25  | 25     | 25  | 25   | 25  | 25    | 25  | 25  |
| Replace Ball Valve, 4"                                     |      |     | 4,105 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     | 4,105  |     |      |     |       |     |     |
| Lubricate, Repack Gland, Ball Valve, 4"                    | 120  | 120 | 120   | 120 | 120 | 120  | 120 | 120 | 120    | 120 | 120  | 120 | 120   | 120 | 120 | 120  | 120 | 120 | 120    | 120 | 120  | 120 | 120   | 120 | 120 |
| Replace Urinal, Vitreous China                             |      |     | 4,711 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Sink, Iron, Enamel                                 |      |     | 6,597 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Tankless Water Closet                              |      |     | 8,492 |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Flush Valve, Tankless Water Closet                 |      |     |       |     |     |      |     |     |        |     |      |     | 271   |     |     |      |     |     |        |     |      |     | 271   |     |     |
| Replace Sink, Stainless Steel                              |      |     |       |     |     |      |     |     | 2,014  |     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |
| Replace Valve Set, Sink, Stainless Steel                   |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     |      |     |     | 265    |     |      |     |       |     |     |
| Repair Strainer, Sink, Stainless Steel                     |      |     |       |     |     |      |     |     |        |     |      |     |       |     |     | 123  |     |     |        |     |      |     |       | 123 |     |
| Replace Faucet Washer & Clean Trap, Sink, Stainless Steel  |      | 42  |       |     | 42  |      | 42  |     | 42     |     | 42   |     | 42    |     | 42  |      | 42  |     | 42     |     | 42   |     | 42    |     | 42  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:                              | 2013 | 4 | 5     | 6 | 7 | 2018 | 9 | 0 | 1   | 2 | 2023 | 4 | 5     | 6 | 7 | 2028 | 9 | 0   | 1 | 2 | 2033 | 4 | 5     | 6 | 7   |  |
|---|------|---|-------|---|---|------|---|---|-----|---|------|---|-------|---|---|------|---|-----|---|---|------|---|-------|---|-----|--|
| Replace Valve Set, Sink, Iron, Enamel       |      |   | 1,191 |   |   |      |   |   |     |   |      |   | 1,191 |   |   |      |   |     |   |   |      |   | 1,191 |   |     |  |
| Repair Strainer, Sink, Iron, Enamel         | 316  |   |       |   |   |      |   |   | 316 |   |      |   |       |   |   |      |   | 316 |   |   |      |   |       |   | 316 |  |
| Replace Flush Valve, Urinal, Vitreous China |      |   |       |   |   | 833  |   |   |     |   |      |   | 833   |   |   |      |   |     |   |   | 833  |   |       |   |     |  |

## D30 HVAC

|  |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       |        |     |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-----|
| Replace Ball Valve, 1"                                       |       |       |       |       |       |       |       |       |       |       | 6,552  |       |       |       |       |       |       |       |       |       |       |       |       |       |        |     |
| Lubricate, Repack Gland, Ball Valve, 1"                      | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   |       | 540    | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540    | 540 |
| Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20 |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 1,172  |     |
| Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam     |       |       | 278   |       |       |       |       |       | 278   |       |        |       |       | 278   |       |       |       |       |       |       |       |       |       |       | 278    |     |
| Replace 10' Section, Pipe & Fittings, 10" Steel              |       |       |       |       | 95    |       |       |       |       |       |        |       |       |       |       |       |       | 95    |       |       |       |       |       |       |        |     |
| Maintain Circulation Pump, 15 HP, Chiller & Condenser Water  | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90     | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90     |     |
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel        |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 81     |     |
| Install New Gasket & Bolts, Pipe & Fittings, 10" Steel       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 24     |     |
| Lubricate, Repack Gland, Ball Valve, 4"                      | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787  | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 |       | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787  |     |
| Lubricate, Repack Gland, Butterfly Valve, 6"                 | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312    | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312    |     |
| Maintain Circulation Pump, 50 HP, Chiller & Condenser Water  | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107    | 107   | 107   | 107   | 107   | 107   |       | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107    |     |
| Replace Butterfly Valve, 6"                                  |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 8,232  |     |
| Repair Circulation Pump, 15 HP, Chiller & Condenser Water    | 321   |       |       |       |       |       |       |       | 321   |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 321    |     |
| Replace Circulation Pump, 15 HP, Chiller & Condenser Water   |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 11,910 |     |
| Replace 10' Section, Pipe & Fittings, 4" Steel               |       |       |       |       | 191   |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 191    |     |
| Clean Fire Box, Gas Boiler, 2,500 Mbh                        | 139   |       | 139   |       |       |       |       | 139   |       |       |        |       | 139   |       |       |       |       |       |       |       | 139   |       |       | 139   | 139    |     |
| Replace Ball Valve, 4"                                       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 24,646 |     |
| Replace Metal Flue, Stainless Steel, 10"                     |       |       |       |       |       |       |       |       |       |       | 27,326 |       |       |       |       |       |       |       |       |       |       |       |       |       | 27,326 |     |
| Maintain Flow Control Valve & Actuator, 2"                   | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002  | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002  |     |
| Maintain Circulation Pump, 25 HP, Hot Water                  | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   |        |       | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107    |     |
| Repair Circulation Pump, 25 HP, Hot Water                    |       |       |       |       | 416   |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 416    |     |
| Replace Circulation Pump, 25 HP, Hot Water                   |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 19,701 |     |
| Maintain Expansion Tank, 100 Gal.                            | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21     | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21     |     |
| Replace Expansion Tank, 100 Gal.                             |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       |        |     |
| Replace Gas Boiler, 2,500 Mbh                                |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       |        |     |
| Repair Gas Boiler, 2,500 Mbh                                 | 9,941 |       |       |       |       |       |       |       | 9,941 |       |        |       |       |       |       |       |       |       |       |       | 9,941 |       |       |       | 9,941  |     |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel        |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 28     |     |
| Resolder Joint, Pipe & Fittings, 3/4" Copper                 |       |       | 206   |       |       |       |       |       |       |       |        |       |       | 206   |       |       |       |       |       |       |       |       |       |       |        |     |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper            |       |       |       |       |       |       |       |       |       |       |        |       |       | 111   |       |       |       |       |       |       |       |       |       |       |        |     |
| Replace Pipe & Fittings, 3/4" Copper (20% of Pipe)           |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 2,233  |     |
| Resolder Joint, Pipe & Fittings, 2" Copper                   |       |       | 376   |       |       |       |       |       |       |       |        |       |       | 376   |       |       |       |       |       |       |       |       |       |       |        |     |
| Replace 10' Section, Pipe & Fittings, 2" Copper              |       |       |       |       |       |       |       |       |       |       |        |       |       | 476   |       |       |       |       |       |       |       |       |       |       |        |     |
| Replace Pipe & Fittings, 2" Copper (20% of Pipe)             |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |       |       | 9,516  |     |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:                              | 2038 | 9 | 0 | 1 | 2 | 2043 | 4 | 5 | 6 | 7 | 2048 | 9 | 0 | 1 | 2 | 2053 | 4 | 5 | 6 | 7 | 2058 | 9 | 0 | 1 | 2 |       |
|---|------|---|---|---|---|------|---|---|---|---|------|---|---|---|---|------|---|---|---|---|------|---|---|---|---|-------|
| Replace Valve Set, Sink, Iron, Enamel       |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   | 1,191 |
| Repair Strainer, Sink, Iron, Enamel         |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   | 316   |
| Replace Flush Valve, Urinal, Vitreous China |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   |      |   |   |   |   | 833   |

## D30 HVAC

|  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |        |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Replace Ball Valve, 1"                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 6,552 |        |
| Lubricate, Repack Gland, Ball Valve, 1"                      | 540   |       | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540   | 540    |
| Replace Pipe Insulation, Fiberglass, Heating Water/Steam (20 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 1,172  |
| Re-tape Pipe Insulation, Fiberglass, Heating Water/Steam     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 278    |
| Replace 10' Section, Pipe & Fittings, 10" Steel              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 95     |
| Maintain Circulation Pump, 15 HP, Chiller & Condenser Water  | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90    | 90     |
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 81     |
| Install New Gasket & Bolts, Pipe & Fittings, 10" Steel       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 24     |
| Lubricate, Repack Gland, Ball Valve, 4"                      | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787 | 1,787  |
| Lubricate, Repack Gland, Butterfly Valve, 6"                 | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312   | 312    |
| Maintain Circulation Pump, 50 HP, Chiller & Condenser Water  | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107    |
| Replace Butterfly Valve, 6"                                  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |        |
| Repair Circulation Pump, 15 HP, Chiller & Condenser Water    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 321    |
| Replace Circulation Pump, 15 HP, Chiller & Condenser Water   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 11,910 |
| Replace 10' Section, Pipe & Fittings, 4" Steel               |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 191    |
| Clean Fire Box, Gas Boiler, 2,500 Mbh                        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 139    |
| Replace Ball Valve, 4"                                       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 24,646 |
| Replace Metal Flue, Stainless Steel, 10"                     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 27,326 |
| Maintain Flow Control Valve & Actuator, 2"                   | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002  |
| Maintain Circulation Pump, 25 HP, Hot Water                  | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107   | 107    |
| Repair Circulation Pump, 25 HP, Hot Water                    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 416    |
| Replace Circulation Pump, 25 HP, Hot Water                   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 19,701 |
| Maintain Expansion Tank, 100 Gal.                            | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21    | 21     |
| Replace Expansion Tank, 100 Gal.                             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 2,697  |
| Replace Gas Boiler, 2,500 Mbh                                |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 81,508 |
| Repair Gas Boiler, 2,500 Mbh                                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 9,941  |
| Install New Gasket & Bolts, Pipe & Fittings, 1" Steel        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 28     |
| Resolder Joint, Pipe & Fittings, 3/4" Copper                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 206    |
| Replace 10' Section, Pipe & Fittings, 3/4" Copper            |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 111    |
| Replace Pipe & Fittings, 3/4" Copper (20% of Pipe)           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 2,233  |
| Resolder Joint, Pipe & Fittings, 2" Copper                   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 376    |
| Replace 10' Section, Pipe & Fittings, 2" Copper              |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 476    |
| Replace Pipe & Fittings, 2" Copper (20% of Pipe)             |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | 9,516  |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2013   | 4      | 5       | 6      | 7      | 2018   | 9      | 0      | 1      | 2      | 2023   | 4      | 5       | 6      | 7      | 2028   | 9      | 0      | 1      | 2      | 2033   | 4      | 5      | 6      | 7       |
|--|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| Replace 10' Section, Pipe & Fittings, 1" Steel             |        |        |         |        |        | 37     |        |        |        |        |        |        |         |        |        |        | 37     |        |        |        |        |        |        |        |         |
| Inspect & Test Gas Boiler, 2,500 Mbh                       | 3,583  | 3,583  | 3,583   | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583   | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583   |
| Maintain Exhaust Fan, Roof Mounted, 400 Cfm                | 475    | 475    | 475     | 475    | 475    | 475    | 475    | 475    | 475    | 475    | 475    | 475    | 475     | 475    | 475    | 475    |        | 475    | 475    | 475    | 475    | 475    | 475    | 475    | 475     |
| Maintain Humidifier, Steam, Duct w/ Controls               | 2,691  | 2,691  | 2,691   | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691   | 2,691  | 2,691  | 2,691  |        | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691   |
| Replace Exhaust Fan, Roof Mounted, 2,000 Cfm               |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 1,390   |
| Repair Exhaust Fan, Roof Mounted, 2,000 Cfm                |        |        |         |        |        | 205    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Roof Mounted, 2,000 Cfm              | 99     | 99     | 99      | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99     | 99     | 99     |        | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      |
| Replace Exhaust Fan, Roof Mounted, 1,500 Cfm               |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 2,602   |
| Repair Exhaust Fan, Roof Mounted, 1,500 Cfm                |        |        |         |        |        | 415    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Roof Mounted, 1,500 Cfm              | 190    | 190    | 190     | 190    | 190    | 190    | 190    | 190    | 190    | 190    | 190    | 190    | 190     | 190    | 190    | 190    |        | 190    | 190    | 190    | 190    | 190    | 190    | 190    | 190     |
| Replace Exhaust Fan, Roof Mounted, 800 Cfm                 |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 1,155   |
| Repair Exhaust Fan, Roof Mounted, 800 Cfm                  |        |        |         |        |        | 205    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Roof Mounted, 800 Cfm                | 99     | 99     | 99      | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99     | 99     | 99     |        | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      |
| Maintain Exhaust Fan, Propeller, 800 Cfm                   | 99     | 99     | 99      | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99     | 99     | 99     |        | 99     | 99     | 99     | 99     | 99     | 99     | 99     | 99      |
| Repair Exhaust Fan, Roof Mounted, 400 Cfm                  |        |        |         |        |        | 1,038  |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Repair Variable Air Volume Box, 400 Cfm                    |        | 5,432  |         |        |        |        |        |        |        |        |        |        |         | 5,432  |        |        |        |        |        |        |        |        |        |        |         |
| Replace Exhaust Fan, Propeller, 7,500 Cfm                  |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 4,129   |
| Repair Exhaust Fan, Propeller, 7,500 Cfm                   |        |        |         |        |        | 410    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Propeller, 7,500 Cfm                 | 198    | 198    | 198     | 198    | 198    | 198    | 198    | 198    | 198    | 198    | 198    | 198    | 198     | 198    | 198    | 198    |        | 198    | 198    | 198    | 198    | 198    | 198    | 198    | 198     |
| Replace Exhaust Fan, Propeller, 4,700 Cfm                  |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 15,755  |
| Repair Exhaust Fan, Propeller, 4,700 Cfm                   |        |        |         |        |        | 1,845  |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Propeller, 4,700 Cfm                 | 890    | 890    | 890     | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890     | 890    | 890    | 890    |        | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890     |
| Replace Exhaust Fan, Propeller, 1,000 Cfm                  |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 4,243   |
| Repair Exhaust Fan, Propeller, 1,000 Cfm                   |        |        |         |        |        | 820    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Exhaust Fan, Propeller, 1,000 Cfm                 | 395    | 395    | 395     | 395    | 395    | 395    | 395    | 395    | 395    | 395    | 395    | 395    | 395     | 395    | 395    | 395    |        | 395    | 395    | 395    | 395    | 395    | 395    | 395    | 395     |
| Replace Exhaust Fan, Propeller, 800 Cfm                    |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 948     |
| Repair Exhaust Fan, Propeller, 800 Cfm                     |        |        |         |        |        | 205    |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Replace Exhaust Fan, Roof Mounted, 400 Cfm                 |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 5,046   |
| Replace Radiant Heating Panel, Electric                    |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 454     |
| Repair Circulation Pump, 50 HP, Chiller & Condenser Water  | 416    |        |         |        |        |        |        |        | 416    |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 416     |
| Replace Circulation Pump, 50 HP, Chiller & Condenser Water |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 37,926  |
| Replace Direct Digital Controls, System Points             |        |        | 362,154 |        |        |        |        |        |        |        |        |        | 362,154 |        |        |        |        |        |        |        |        |        |        |        | 362,154 |
| Monitor Direct Digital Controls, System Points             | 11,474 | 11,474 |         | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474  | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474  |
| Replace Unit Heater, 36 Mbh                                |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 8,181   |
| Repair Unit Heater, 36 Mbh                                 |        |        |         |        |        |        |        |        | 4,190  |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        |         |
| Maintain Unit Heater, 36 Mbh                               | 890    | 890    | 890     | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890     | 890    | 890    | 890    |        | 890    | 890    | 890    | 890    | 890    | 890    | 890    | 890     |
| Replace Unit Heater, 12 Mbh                                |        |        |         |        |        |        |        |        |        |        |        |        |         |        |        |        |        |        |        |        |        |        |        |        | 2,790   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038   | 9      | 0      | 1      | 2      | 2043   | 4       | 5     | 6      | 7      | 2048   | 9      | 0      | 1      | 2      | 2053   | 4       | 5     | 6     | 7      | 2058   | 9      | 0      | 1      | 2      |
|--|--------|--------|--------|--------|--------|--------|---------|-------|--------|--------|--------|--------|--------|--------|--------|--------|---------|-------|-------|--------|--------|--------|--------|--------|--------|
| Replace 10' Section, Pipe & Fittings, 1" Steel             |        |        |        | 37     |        |        |         |       |        |        |        |        |        |        |        | 37     |         |       |       |        |        |        |        |        |        |
| Inspect & Test Gas Boiler, 2,500 Mbh                       | 3,583  | 3,583  | 3,583  |        | 3,583  | 3,583  | 3,583   | 3,583 | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583   | 3,583 | 3,583 | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  | 3,583  |
| Maintain Exhaust Fan, Roof Mounted, 400 Cfm                | 475    | 475    | 475    | 475    | 475    | 475    | 475     | 475   | 475    | 475    | 475    | 475    | 475    | 475    | 475    |        | 475     | 475   | 475   | 475    | 475    | 475    | 475    | 475    | 475    |
| Maintain Humidifier, Steam, Duct w/ Controls               | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691   | 2,691 | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  |        | 2,691   | 2,691 | 2,691 | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  | 2,691  |
| Replace Exhaust Fan, Roof Mounted, 2,000 Cfm               |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 1,390  |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Roof Mounted, 2,000 Cfm                |        |        |        |        | 205    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Roof Mounted, 2,000 Cfm              | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99    | 99     | 99     | 99     | 99     | 99     | 99     | 99     |        | 99      | 99    | 99    | 99     | 99     | 99     | 99     | 99     | 99     |
| Replace Exhaust Fan, Roof Mounted, 1,500 Cfm               |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 2,602  |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Roof Mounted, 1,500 Cfm                |        |        |        |        | 415    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Roof Mounted, 1,500 Cfm              | 190    | 190    | 190    | 190    | 190    | 190    | 190     | 190   | 190    | 190    | 190    | 190    | 190    | 190    | 190    |        | 190     | 190   | 190   | 190    | 190    | 190    | 190    | 190    | 190    |
| Replace Exhaust Fan, Roof Mounted, 800 Cfm                 |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 1,155  |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Roof Mounted, 800 Cfm                  |        |        |        |        | 205    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Roof Mounted, 800 Cfm                | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99    | 99     | 99     | 99     | 99     | 99     | 99     | 99     |        | 99      | 99    | 99    | 99     | 99     | 99     | 99     | 99     | 99     |
| Maintain Exhaust Fan, Propeller, 800 Cfm                   | 99     | 99     | 99     | 99     | 99     | 99     | 99      | 99    | 99     | 99     | 99     | 99     | 99     | 99     | 99     |        | 99      | 99    | 99    | 99     | 99     | 99     | 99     | 99     | 99     |
| Repair Exhaust Fan, Roof Mounted, 400 Cfm                  |        |        |        |        | 1,038  |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Repair Variable Air Volume Box, 400 Cfm                    |        |        | 5,432  |        |        |        |         |       |        |        |        |        |        |        |        | 5,432  |         |       |       |        |        |        |        |        |        |
| Replace Exhaust Fan, Propeller, 7,500 Cfm                  |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 4,129  |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Propeller, 7,500 Cfm                   |        |        |        |        | 410    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Propeller, 7,500 Cfm                 | 198    | 198    | 198    | 198    | 198    | 198    | 198     | 198   | 198    | 198    | 198    | 198    | 198    | 198    | 198    |        | 198     | 198   | 198   | 198    | 198    | 198    | 198    | 198    | 198    |
| Replace Exhaust Fan, Propeller, 4,700 Cfm                  |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 15,755 |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Propeller, 4,700 Cfm                   |        |        |        |        | 1,845  |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Propeller, 4,700 Cfm                 | 890    | 890    | 890    | 890    | 890    | 890    | 890     | 890   | 890    | 890    | 890    | 890    | 890    | 890    | 890    |        | 890     | 890   | 890   | 890    | 890    | 890    | 890    | 890    | 890    |
| Replace Exhaust Fan, Propeller, 1,000 Cfm                  |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 4,243  |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Propeller, 1,000 Cfm                   |        |        |        |        | 820    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Exhaust Fan, Propeller, 1,000 Cfm                 | 395    | 395    | 395    | 395    | 395    | 395    | 395     | 395   | 395    | 395    | 395    | 395    | 395    | 395    | 395    |        | 395     | 395   | 395   | 395    | 395    | 395    | 395    | 395    | 395    |
| Replace Exhaust Fan, Propeller, 800 Cfm                    |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 948    |         |       |       |        |        |        |        |        |        |
| Repair Exhaust Fan, Propeller, 800 Cfm                     |        |        |        |        | 205    |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Replace Exhaust Fan, Roof Mounted, 400 Cfm                 |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 5,046  |         |       |       |        |        |        |        |        |        |
| Replace Radiant Heating Panel, Electric                    |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 454    |         |       |       |        |        |        |        |        |        |
| Repair Circulation Pump, 50 HP, Chiller & Condenser Water  |        |        |        |        |        | 416    |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        | 416    |        |        |        |
| Replace Circulation Pump, 50 HP, Chiller & Condenser Water |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 37,926 |         |       |       |        |        |        |        |        |        |
| Replace Direct Digital Controls, System Points             |        |        |        |        |        |        | 362,154 |       |        |        |        |        |        |        |        |        | 362,154 |       |       |        |        |        |        |        |        |
| Monitor Direct Digital Controls, System Points             | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474  |       | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 |         |       |       | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 | 11,474 |
| Replace Unit Heater, 36 Mbh                                |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 8,181  |         |       |       |        |        |        |        |        |        |
| Repair Unit Heater, 36 Mbh                                 |        |        |        |        | 4,190  |        |         |       |        |        |        |        |        |        |        |        |         |       |       |        |        |        |        |        |        |
| Maintain Unit Heater, 36 Mbh                               | 890    | 890    | 890    | 890    | 890    | 890    | 890     | 890   | 890    | 890    | 890    | 890    | 890    | 890    | 890    |        | 890     | 890   | 890   | 890    | 890    | 890    | 890    | 890    | 890    |
| Replace Unit Heater, 12 Mbh                                |        |        |        |        |        |        |         |       |        |        |        |        |        |        |        | 2,790  |         |       |       |        |        |        |        |        |        |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2013  | 4     | 5     | 6     | 7     | 2018   | 9     | 0     | 1     | 2     | 2023  | 4     | 5     | 6     | 7     | 2028   | 9     | 0      | 1   | 2     | 2033  | 4     | 5      | 6     | 7     |
|--|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|--------|-----|-------|-------|-------|--------|-------|-------|
| Repair Unit Heater, 12 Mbh                                     |       |       |       |       |       |        |       | 1,818 |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        |       |       |
| Maintain Unit Heater, 12 Mbh                                   | 509   | 509   | 509   | 509   | 509   | 509    | 509   | 509   | 509   | 509   | 509   | 509   | 509   | 509   | 509   | 509    | 509   | 509    | 509 | 509   | 509   | 509   | 509    | 509   | 509   |
| Replace Secondary Coil, 24" x 36"                              |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 1,130 |       |
| Replace Humidifier, Steam, Duct w/ Controls                    |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 92,521 |       |        |     |       |       |       |        |       |       |
| Replace Secondary Coil, 12" x 24"                              |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 2,724 |       |
| Maintain Variable Air Volume Box, 400 Cfm                      | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 |        | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579  | 3,579 |        |     | 3,579 | 3,579 | 3,579 | 3,579  | 3,579 | 3,579 |
| Maintain Radiant Heating Panel, Electric                       | 104   | 104   | 104   | 104   | 104   | 104    | 104   | 104   | 104   | 104   | 104   | 104   | 104   | 104   | 104   | 104    | 104   | 104    | 104 | 104   | 104   | 104   | 104    | 104   | 104   |
| Repair Variable Air Volume Box, 2,500 Cfm                      |       | 558   |       |       |       |        |       |       |       |       |       |       |       |       | 558   |        |       |        |     |       |       |       |        |       |       |
| Maintain Variable Air Volume Box, 2,500 Cfm                    | 394   | 394   | 394   | 394   | 394   |        | 394   | 394   | 394   | 394   | 394   | 394   | 394   | 394   | 394   | 394    | 394   |        |     | 394   | 394   | 394   | 394    | 394   | 394   |
| Replace Variable Air Volume Box, 1,300 Cfm                     |       |       |       |       |       | 41,233 |       |       |       |       |       |       |       |       |       |        |       | 41,233 |     |       |       |       |        |       |       |
| Repair Variable Air Volume Box, 1,300 Cfm                      |       | 5,152 |       |       |       |        |       |       |       |       |       |       |       |       | 5,152 |        |       |        |     |       |       |       |        |       |       |
| Maintain Variable Air Volume Box, 1,300 Cfm                    | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 |        | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041  | 3,041 |        |     | 3,041 | 3,041 | 3,041 | 3,041  | 3,041 | 3,041 |
| Replace Variable Air Volume Box, 800 Cfm                       |       |       |       |       |       | 28,939 |       |       |       |       |       |       |       |       |       |        |       | 28,939 |     |       |       |       |        |       |       |
| Repair Variable Air Volume Box, 800 Cfm                        |       | 3,822 |       |       |       |        |       |       |       |       |       |       |       |       | 3,822 |        |       |        |     |       |       |       |        |       |       |
| Maintain Variable Air Volume Box, 800 Cfm                      | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 |        | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554  | 2,554 |        |     | 2,554 | 2,554 | 2,554 | 2,554  | 2,554 | 2,554 |
| Replace Variable Air Volume Box, 400 Cfm                       |       |       |       |       |       | 33,194 |       |       |       |       |       |       |       |       |       |        |       | 33,194 |     |       |       |       |        |       |       |
| Replace Variable Air Volume Box, 2,500 Cfm                     |       |       |       |       |       | 7,601  |       |       |       |       |       |       |       |       |       |        |       | 7,601  |     |       |       |       |        |       |       |
| Replace Secondary Coil, 24" x 24"                              |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 3,208 |       |
| Replace 10' Section, Pipe & Fittings, 4" Steel                 |       |       |       |       | 319   |        |       |       |       |       |       |       |       |       |       |        | 319   |        |     |       |       |       |        |       |       |
| Maintain Air Handler, Multizone, 10,000 Cfm                    | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 |        | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448  | 3,448 |        |     | 3,448 | 3,448 | 3,448 | 3,448  | 3,448 | 3,448 |
| Repair Air Handler, Multizone, 5,200 Cfm                       |       | 4,120 |       |       |       |        |       |       |       |       |       |       |       |       | 4,120 |        |       |        |     |       |       |       |        |       |       |
| Replace Pipe Insulation, Fiberglass, Chilled Water (20% of Ins |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       | 1,261  |     |       |       |       |        |       |       |
| Re-tape Pipe Insulation, Fiberglass, Chilled Water             |       |       | 416   |       |       |        |       | 416   |       |       |       |       | 416   |       |       |        |       |        |     |       |       |       |        | 416   |       |
| Install New Gasket & Bolts, Pipe & Fittings, 10" Steel         |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 17    |       |
| Replace 10' Section, Pipe & Fittings, 10" Steel                |       |       |       |       | 66    |        |       |       |       |       |       |       |       |       |       |        | 66    |        |     |       |       |       |        |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 8" Steel          |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 24    |       |
| Replace 10' Section, Pipe & Fittings, 8" Steel                 |       |       |       |       | 70    |        |       |       |       |       |       |       |       |       |       |        | 70    |        |     |       |       |       |        |       |       |
| Replace Valve Actuator, 2"                                     |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 13,586 |       |        |     |       |       |       |        |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 6" Steel          |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 133   |       |
| Repair Air Handler, Multizone, 10,000 Cfm                      |       | 9,384 |       |       |       |        |       |       |       |       |       |       |       |       | 9,384 |        |       |        |     |       |       |       |        |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel          |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 135   |       |
| Replace Air Handler, Multizone, 5,200 Cfm                      |       |       |       |       |       | 32,288 |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       | 32,288 |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel          |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 124   |       |
| Replace 10' Section, Pipe & Fittings, 2" Steel                 |       |       |       |       | 220   |        |       |       |       |       |       |       |       |       |       |        | 220   |        |     |       |       |       |        |       |       |
| Replace Flow Control Valve, Motorized, 6"                      |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |       |        |     |       |       |       |        | 9,378 |       |
| Replace Valve Actuator, 6"                                     |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 9,056  |       |        |     |       |       |       |        |       |       |
| Maintain Flow Control Valve & Actuator, 6"                     | 167   | 167   | 167   | 167   | 167   | 167    | 167   | 167   | 167   | 167   | 167   | 167   | 167   | 167   | 167   | 167    | 167   |        |     | 167   | 167   | 167   | 167    | 167   | 167   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2038  | 9     | 0     | 1     | 2     | 2043  | 4      | 5     | 6     | 7     | 2048  | 9     | 0     | 1     | 2     | 2053   | 4     | 5     | 6     | 7   | 2058   | 9      | 0     | 1     | 2     |
|---|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-----|--------|--------|-------|-------|-------|
| Repair Unit Heater, 12 Mbh                                    |       |       |       |       |       | 1,818 |        |       |       |       |       |       |       |       |       |        |       |       |       |     |        |        |       |       |       |
| Maintain Unit Heater, 12 Mbh                                  | 509   | 509   | 509   | 509   | 509   | 509   | 509    | 509   | 509   | 509   | 509   | 509   | 509   |       |       | 509    | 509   | 509   | 509   | 509 | 509    | 509    | 509   | 509   | 509   |
| Replace Secondary Coil, 24" x 36"                             |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     |        |        |       |       |       |
| Replace Humidifier, Steam, Duct w/ Controls                   |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       | 92,521 |       |       |       |     |        |        |       |       |       |
| Replace Secondary Coil, 12" x 24"                             |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     |        |        |       |       |       |
| Maintain Variable Air Volume Box, 400 Cfm                     | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 |        | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579 | 3,579  | 3,579 | 3,579 | 3,579 |     | 3,579  | 3,579  | 3,579 | 3,579 | 3,579 |
| Maintain Radiant Heating Panel, Electric                      | 104   | 104   | 104   | 104   | 104   | 104   | 104    | 104   | 104   | 104   | 104   | 104   | 104   |       |       | 104    | 104   | 104   | 104   | 104 | 104    | 104    | 104   | 104   | 104   |
| Repair Variable Air Volume Box, 2,500 Cfm                     |       |       |       |       |       | 558   |        |       |       |       |       |       |       |       |       | 558    |       |       |       |     |        |        |       |       |       |
| Maintain Variable Air Volume Box, 2,500 Cfm                   | 394   | 394   | 394   | 394   | 394   | 394   |        | 394   | 394   | 394   | 394   | 394   | 394   | 394   | 394   | 394    | 394   | 394   | 394   | 394 |        | 394    | 394   | 394   | 394   |
| Replace Variable Air Volume Box, 1,300 Cfm                    |       |       |       |       |       |       | 41,233 |       |       |       |       |       |       |       |       |        |       |       |       |     | 41,233 |        |       |       |       |
| Repair Variable Air Volume Box, 1,300 Cfm                     |       |       |       |       |       | 5,152 |        |       |       |       |       |       |       |       |       | 5,152  |       |       |       |     |        |        |       |       |       |
| Maintain Variable Air Volume Box, 1,300 Cfm                   | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 |        | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041 | 3,041  | 3,041 | 3,041 | 3,041 |     | 3,041  | 3,041  | 3,041 | 3,041 | 3,041 |
| Replace Variable Air Volume Box, 800 Cfm                      |       |       |       |       |       |       | 28,939 |       |       |       |       |       |       |       |       |        |       |       |       |     | 28,939 |        |       |       |       |
| Repair Variable Air Volume Box, 800 Cfm                       |       |       |       |       |       | 3,822 |        |       |       |       |       |       |       |       |       | 3,822  |       |       |       |     |        |        |       |       |       |
| Maintain Variable Air Volume Box, 800 Cfm                     | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 |        | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554 | 2,554  | 2,554 | 2,554 | 2,554 |     | 2,554  | 2,554  | 2,554 | 2,554 |       |
| Replace Variable Air Volume Box, 400 Cfm                      |       |       |       |       |       |       | 33,194 |       |       |       |       |       |       |       |       |        |       |       |       |     | 33,194 |        |       |       |       |
| Replace Variable Air Volume Box, 2,500 Cfm                    |       |       |       |       |       |       | 7,601  |       |       |       |       |       |       |       |       |        |       |       |       |     | 7,601  |        |       |       |       |
| Replace Secondary Coil, 24" x 24"                             |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     |        |        |       |       |       |
| Replace 10' Section, Pipe & Fittings, 4" Steel                |       |       |       |       |       | 319   |        |       |       |       |       |       |       |       |       | 319    |       |       |       |     |        |        |       |       |       |
| Maintain Air Handler, Multizone, 10,000 Cfm                   | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 |        | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448 | 3,448  | 3,448 | 3,448 | 3,448 |     | 3,448  | 3,448  | 3,448 | 3,448 | 3,448 |
| Repair Air Handler, Multizone, 5,200 Cfm                      |       |       |       |       |       | 4,120 |        |       |       |       |       |       |       |       |       | 4,120  |       |       |       |     |        |        |       |       |       |
| Replace Pipe Insulation, Fiberglass, Chilled Water (20% of In |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 1,261  |        |       |       |       |
| Re-tape Pipe Insulation, Fiberglass, Chilled Water            |       |       |       |       |       | 416   |        |       | 416   |       |       |       |       |       |       | 416    |       |       |       |     |        |        | 416   |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 10" Steel        |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 17     |        |       |       |       |
| Replace 10' Section, Pipe & Fittings, 10" Steel               |       |       |       |       |       | 66    |        |       |       |       |       |       |       |       |       | 66     |       |       |       |     |        |        |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 8" Steel         |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 24     |        |       |       |       |
| Replace 10' Section, Pipe & Fittings, 8" Steel                |       |       |       |       |       | 70    |        |       |       |       |       |       |       |       |       | 70     |       |       |       |     |        |        |       |       |       |
| Replace Valve Actuator, 2"                                    |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 13,586 |        |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 6" Steel         |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 133    |        |       |       |       |
| Repair Air Handler, Multizone, 10,000 Cfm                     |       |       |       |       |       | 9,384 |        |       |       |       |       |       |       |       |       | 9,384  |       |       |       |     |        |        |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel         |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 135    |        |       |       |       |
| Replace Air Handler, Multizone, 5,200 Cfm                     |       |       |       |       |       |       | 32,288 |       |       |       |       |       |       |       |       |        |       |       |       |     |        | 32,288 |       |       |       |
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel         |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 124    |        |       |       |       |
| Replace 10' Section, Pipe & Fittings, 2" Steel                |       |       |       |       |       | 220   |        |       |       |       |       |       |       |       |       | 220    |       |       |       |     |        |        |       |       |       |
| Replace Flow Control Valve, Motorized, 6"                     |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 9,378  |        |       |       |       |
| Replace Valve Actuator, 6"                                    |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |        |       |       |       |     | 9,056  |        |       |       |       |
| Maintain Flow Control Valve & Actuator, 6"                    | 167   | 167   | 167   | 167   | 167   | 167   | 167    | 167   | 167   | 167   | 167   | 167   | 167   | 167   | 167   | 167    | 167   | 167   | 167   |     | 167    | 167    | 167   | 167   | 167   |



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:                                 | 2013  | 4     | 5     | 6     | 7     | 2018    | 9     | 0     | 1     | 2     | 2023  | 4     | 5     | 6     | 7     | 2028  | 9     | 0     | 1   | 2   | 2033  | 4     | 5     | 6     | 7     |        |         |
|--|-------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-------|-------|-------|-------|-------|--------|---------|
| Replace Flow Control Valve, Motorized, 4"      |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       | 50,520 |         |
| Replace Valve Actuator, 4"                     |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 28,179  |
| Maintain Flow Control Valve & Actuator, 4"     | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336   | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 |     |     | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336  |         |
| Replace Flow Control Valve, Motorized, 2"      |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 20,155  |
| Repair Wiring, Radiant Heating Panel, Electric | 36    |       | 36    |       | 36    |         | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36  |     | 36    |       | 36    |       | 36    |        | 36      |
| Replace Exhaust Fan, Propeller, 375 Cfm        |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 1,334   |
| Replace 10' Section, Pipe & Fittings, 6" Steel |       |       |       |       |       | 297     |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 297     |
| Maintain Air Handler, Single Zone, 5,000 Cfm   | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 |         | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 |     |     | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209  |         |
| Repair Exhaust Fan, Propeller, 375 Cfm         |       |       |       |       |       | 410     |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        |         |
| Maintain Exhaust Fan, Propeller, 375 Cfm       | 198   | 198   | 198   | 198   | 198   | 198     | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   |       |     | 198 | 198   | 198   | 198   | 198   | 198   | 198    |         |
| Replace Exhaust Fan, Centrifugal, 250 Cfm      |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 1,132   |
| Repair Exhaust Fan, Centrifugal, 250 Cfm       |       |       |       |       |       | 410     |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        |         |
| Maintain Exhaust Fan, Centrifugal, 250 Cfm     | 116   | 116   | 116   | 116   | 116   | 116     | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   |       |       | 116 | 116 | 116   | 116   | 116   | 116   | 116   | 116    |         |
| Replace Existing Ductwork (20% of Ductwork)    |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        |         |
| Replace Duct Insulation (20% of Insulation)    |       |       |       |       |       |         |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        |         |
| Replace Air Handler, Single Zone, 10,000 Cfm   |       |       |       |       |       | 73,791  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 73,791  |
| Repair Air Handler, Single Zone, 10,000 Cfm    |       | 5,560 |       |       |       |         |       |       |       |       |       |       |       |       |       | 5,560 |       |       |     |     |       |       |       |       |       |        |         |
| Maintain Air Handler, Single Zone, 10,000 Cfm  | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 |         | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 |     |     | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462  |         |
| Maintain Air Handler, Multizone, 5,200 Cfm     | 892   | 892   | 892   | 892   | 892   |         | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   |     |     | 892   | 892   | 892   | 892   | 892   | 892    |         |
| Repair Air Handler, Single Zone, 5,000 Cfm     |       | 8,199 |       |       |       |         |       |       |       |       |       |       |       |       |       | 8,199 |       |       |     |     |       |       |       |       |       |        |         |
| Replace Air Handler, Multizone, 10,000 Cfm     |       |       |       |       |       | 112,251 |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 112,251 |
| Replace Air Handler, Single Zone, 2,500 Cfm    |       |       |       |       |       | 18,109  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 18,109  |
| Maintain Air Handler, Multizone, 25,000 Cfm    | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 |         | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 |     |     | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002  |         |
| Maintain Air Handler, Multizone, 15,000 Cfm    | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 |         | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 |     |     | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724  |         |
| Repair Air Handler, Multizone, 15,000 Cfm      |       | 5,881 |       |       |       |         |       |       |       |       |       |       |       |       |       | 5,881 |       |       |     |     |       |       |       |       |       |        |         |
| Replace Air Handler, Single Zone, 5,000 Cfm    |       |       |       |       |       | 71,425  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 71,425  |
| Replace Air Handler, Multizone, 15,000 Cfm     |       |       |       |       |       | 76,180  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 76,180  |
| Repair Air Handler, Multizone, 25,000 Cfm      |       | 3,603 |       |       |       |         |       |       |       |       |       |       |       |       |       | 3,603 |       |       |     |     |       |       |       |       |       |        |         |
| Replace Air Handler, Multizone, 25,000 Cfm     |       |       |       |       |       | 58,959  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 58,959  |
| Maintain Air Handler, Multizone, 30,000 Cfm    | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 |         | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 |     |     | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014  |         |
| Repair Air Handler, Multizone, 30,000 Cfm      |       | 4,446 |       |       |       |         |       |       |       |       |       |       |       |       |       | 4,446 |       |       |     |     |       |       |       |       |       |        |         |
| Replace Air Handler, Multizone, 30,000 Cfm     |       |       |       |       |       | 67,490  |       |       |       |       |       |       |       |       |       |       |       |       |     |     |       |       |       |       |       |        | 67,490  |
| Maintain Air Handler, Single Zone, 2,500 Cfm   | 771   | 771   | 771   | 771   | 771   |         | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   |     |     | 771   | 771   | 771   | 771   | 771   | 771    |         |
| Repair Air Handler, Single Zone, 2,500 Cfm     |       | 3,215 |       |       |       |         |       |       |       |       |       |       |       |       |       | 3,215 |       |       |     |     |       |       |       |       |       |        |         |

## D40 Fire Protection

|   |  |  |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |
|---|--|--|--|--|--|-------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel |  |  |  |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 27    |
| Replace 10' Section, Pipe & Fittings, 2" Steel        |  |  |  |  |  | 1,107 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,107 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:                                 | 2038  | 9     | 0     | 1     | 2     | 2043  | 4     | 5     | 6     | 7     | 2048  | 9     | 0     | 1     | 2     | 2053  | 4     | 5     | 6     | 7   | 2058 | 9     | 0     | 1     | 2     |        |         |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|------|-------|-------|-------|-------|--------|---------|
| Replace Flow Control Valve, Motorized, 4"      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       | 50,520 |         |
| Replace Valve Actuator, 4"                     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 28,179  |
| Maintain Flow Control Valve & Actuator, 4"     | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 | 1,336 |     |      | 1,336 | 1,336 | 1,336 | 1,336 | 1,336  |         |
| Replace Flow Control Valve, Motorized, 2"      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 20,155  |
| Repair Wiring, Radiant Heating Panel, Electric | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |       | 36    |     | 36   |       | 36    |       | 36    |        |         |
| Replace Exhaust Fan, Propeller, 375 Cfm        |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 1,334   |
| Replace 10' Section, Pipe & Fittings, 6" Steel |       |       |       |       | 297   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 297     |
| Maintain Air Handler, Single Zone, 5,000 Cfm   | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 |       | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 | 2,209 |     |      | 2,209 | 2,209 | 2,209 | 2,209 | 2,209  |         |
| Repair Exhaust Fan, Propeller, 375 Cfm         |       |       |       |       |       | 410   |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        |         |
| Maintain Exhaust Fan, Propeller, 375 Cfm       | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198   | 198 | 198  | 198   | 198   | 198   | 198   | 198    |         |
| Replace Exhaust Fan, Centrifugal, 250 Cfm      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 1,132   |
| Repair Exhaust Fan, Centrifugal, 250 Cfm       |       |       |       |       |       | 410   |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        |         |
| Maintain Exhaust Fan, Centrifugal, 250 Cfm     | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116   | 116 | 116  | 116   | 116   | 116   | 116   | 116    |         |
| Replace Existing Ductwork (20% of Ductwork)    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 133,869 |
| Replace Duct Insulation (20% of Insulation)    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 48,517  |
| Replace Air Handler, Single Zone, 10,000 Cfm   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 73,791  |
| Repair Air Handler, Single Zone, 10,000 Cfm    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 73,791  |
| Maintain Air Handler, Single Zone, 10,000 Cfm  | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 |       | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 | 2,462 |     |      | 2,462 | 2,462 | 2,462 | 2,462 | 2,462  |         |
| Maintain Air Handler, Multizone, 5,200 Cfm     | 892   | 892   | 892   | 892   | 892   | 892   |       | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   | 892   |     |      | 892   | 892   | 892   | 892   | 892    |         |
| Repair Air Handler, Single Zone, 5,000 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 8,199   |
| Replace Air Handler, Multizone, 10,000 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 112,251 |
| Replace Air Handler, Single Zone, 2,500 Cfm    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 18,109  |
| Maintain Air Handler, Multizone, 25,000 Cfm    | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 |       | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 | 1,002 |     |      | 1,002 | 1,002 | 1,002 | 1,002 | 1,002  |         |
| Maintain Air Handler, Multizone, 15,000 Cfm    | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 |       | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 | 1,724 |     |      | 1,724 | 1,724 | 1,724 | 1,724 | 1,724  |         |
| Repair Air Handler, Multizone, 15,000 Cfm      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 5,881   |
| Replace Air Handler, Single Zone, 5,000 Cfm    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 71,425  |
| Replace Air Handler, Multizone, 15,000 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 76,180  |
| Repair Air Handler, Multizone, 25,000 Cfm      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 3,603   |
| Replace Air Handler, Multizone, 25,000 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 58,959  |
| Maintain Air Handler, Multizone, 30,000 Cfm    | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 |       | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 | 1,014 |     |      | 1,014 | 1,014 | 1,014 | 1,014 | 1,014  |         |
| Repair Air Handler, Multizone, 30,000 Cfm      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 4,446   |
| Replace Air Handler, Multizone, 30,000 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 67,490  |
| Maintain Air Handler, Single Zone, 2,500 Cfm   | 771   | 771   | 771   | 771   | 771   | 771   |       | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   | 771   |     |      | 771   | 771   | 771   | 771   | 771    |         |
| Repair Air Handler, Single Zone, 2,500 Cfm     |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |     |      |       |       |       |       |        | 3,215   |

## D40 Fire Protection

|   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |       |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|-------|
| Install New Gasket & Bolts, Pipe & Fittings, 4" Steel |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 27    |
| Replace 10' Section, Pipe & Fittings, 2" Steel        |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1,107 |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2013 | 4   | 5      | 6   | 7   | 2018 | 9   | 0     | 1   | 2   | 2023 | 4   | 5      | 6   | 7   | 2028 | 9   | 0   | 1   | 2   | 2033 | 4   | 5   | 6   | 7   |        |
|--|------|-----|--------|-----|-----|------|-----|-------|-----|-----|------|-----|--------|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|--------|
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel    |      |     |        |     |     |      |     |       |     |     |      |     |        |     |     |      |     |     |     |     |      |     |     |     |     | 623    |
| Replace Fire Suppression System Water Pump, 10 HP        |      |     |        |     |     |      |     | 5,856 |     |     |      |     |        |     |     |      |     |     |     |     |      |     |     |     |     | 5,856  |
| Maintain Fire Suppression System Water Pump, 10 HP       | 432  | 432 | 432    | 432 | 432 | 432  | 432 |       | 432 | 432 | 432  | 432 | 432    | 432 | 432 | 432  | 432 | 432 | 432 | 432 | 432  | 432 | 432 | 432 | 432 | 432    |
| Inspect & Test Fire Suppression System Water Pump, 10 HP | 189  | 189 | 189    | 189 | 189 | 189  | 189 |       | 189 | 189 | 189  | 189 | 189    | 189 | 189 | 189  | 189 | 189 | 189 | 189 | 189  | 189 | 189 | 189 | 189 | 189    |
| Test Gages & Valves, Fire Sprinkler System               | 757  | 757 | 757    | 757 | 757 | 757  | 757 | 757   | 757 | 757 | 757  | 757 | 757    | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757    |
| Maintain Fire Sprinkler System                           | 821  | 821 | 821    | 821 | 821 | 821  | 821 | 821   | 821 | 821 | 821  | 821 | 821    | 821 | 821 | 821  | 821 | 821 | 821 | 821 | 821  | 821 | 821 | 821 | 821 | 821    |
| Replace Fire Sprinkler Head                              |      |     |        |     |     |      |     |       |     |     |      |     |        |     |     |      |     |     |     |     |      |     |     |     |     |        |
| Test Fire Sprinkler Head                                 |      |     | 18,605 |     |     |      |     |       |     |     |      |     | 18,605 |     |     |      |     |     |     |     |      |     |     |     |     | 18,605 |
| Inspect Fire Sprinkler Head                              | 373  | 373 | 373    | 373 | 373 | 373  | 373 | 373   | 373 | 373 | 373  | 373 | 373    | 373 | 373 | 373  | 373 | 373 | 373 | 373 | 373  | 373 | 373 | 373 | 373 | 373    |
| Replace Fire Alarm Control Panel                         |      |     |        |     |     |      |     | 3,219 |     |     |      |     |        |     |     |      |     |     |     |     |      |     |     |     |     | 3,219  |
| Repair Fire Alarm Control Panel                          |      |     | 122    |     |     |      |     |       |     |     |      |     | 122    |     |     |      |     |     | 122 |     |      |     |     |     |     |        |
| Inspect & Test Fire Alarm Control Panel                  | 131  | 131 | 131    | 131 | 131 | 131  | 131 |       | 131 | 131 | 131  | 131 | 131    | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131    |
| Replace Valves & Components, Sprinkler System            |      |     |        |     |     |      |     |       |     |     |      |     | 51,645 |     |     |      |     |     |     |     |      |     |     |     |     |        |
| Replace 10' Section, Pipe & Fittings, 4" Steel           |      |     |        |     | 64  |      |     |       |     |     |      |     |        |     |     |      |     | 64  |     |     |      |     |     |     |     |        |

## D50 Electrical

|  |       |       |        |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     |         |
|--|-------|-------|--------|-------|-----|-------|-----|-------|-----|-------|-----|-------|---------|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|-------|-----|---------|
| Replace Exit Lighting Fixture, w/ Battery                      |       |       |        |       |     |       |     |       |     |       |     |       | 4,199   |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2-3 |       |       | 29,822 |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     | 29,822  |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4-3 |       |       | 58,647 |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     | 58,647  |
| Replace Fluorescent Lighting Fixture, T8, 2-32 w               |       |       |        |       |     |       |     |       |     |       |     |       | 47,682  |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Fluorescent Lighting Fixture, T8, 4-32 w               |       |       |        |       |     |       |     |       |     |       |     |       | 93,770  |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Lamp, LED Lighting Fixture, 100 w                      |       |       | 813    |       |     |       |     | 813   |     |       |     |       |         |       |     |       |     | 813   |     |       |     |       |     |       |     | 813     |
| Replace LED Lighting Fixture, 100 w                            |       |       |        |       |     |       |     |       |     |       |     |       | 2,354   |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w      |       |       | 5,267  |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     | 5,267   |
| Replace HP Sodium Lighting Fixture, 250 w                      |       |       |        |       |     |       |     |       |     |       |     |       | 14,923  |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Lamp, Exit Lighting Fixture, w/ Battery                |       |       | 921    |       |     |       |     | 921   |     |       |     |       |         |       |     |       |     | 921   |     |       |     |       |     |       |     | 921     |
| Replace Incandescent Lighting Fixture, Basic, 100 w            |       |       |        |       |     |       |     |       |     |       |     |       | 1,455   |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtur   |       |       | 1,922  |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     | 1,922   |
| Replace Receptacle, 120 V, 20 Amp.                             |       |       |        |       |     |       |     |       |     |       |     |       | 149,616 |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w      |       |       | 96     |       |     |       |     | 96    |     |       |     |       |         |       |     |       |     | 96    |     |       |     |       |     |       |     | 96      |
| Inspect & Clean Variable Frequency Drive, <600 V               | 184   | 184   | 184    | 184   | 184 | 184   | 184 | 184   | 184 | 184   | 184 | 184   | 184     | 184   | 184 | 184   | 184 | 184   | 184 | 184   | 184 | 184   | 184 | 184   | 184 | 184     |
| Maintain Switchboard, 1600 Amp.                                | 102   | 102   | 102    | 102   | 102 | 102   | 102 | 102   | 102 | 102   | 102 | 102   | 102     | 102   | 102 | 102   | 102 | 102   | 102 | 102   | 102 | 102   | 102 | 102   | 102 | 102     |
| Replace Switchboard, 1600 Amp.                                 |       |       |        |       |     |       |     |       |     |       |     |       |         |       |     |       |     |       |     |       |     |       |     |       |     | 148,742 |
| Inspect & Clean Transfer Switch, Auto, 600 V, 150 Amp.         | 21    | 21    | 21     | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21      | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21      |
| Repair Transfer Switch, Auto, 600 V, 150 Amp.                  |       |       | 214    |       |     |       |     | 214   |     |       |     |       |         |       |     |       |     | 214   |     |       |     |       |     |       |     | 214     |
| Replace Transfer Switch, Auto, 600 V, 150 Amp.                 |       |       |        |       |     |       |     |       |     |       |     | 7,443 |         |       |     |       |     |       |     |       |     |       |     |       |     |         |
| Inspect & Clean Transfer Switch, Auto, 600 V, 1,600 Amp.       | 21    | 21    | 21     | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21      | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21    | 21  | 21      |
| Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/ B    | 2,700 | 2,700 |        | 2,700 |     | 2,700 |     | 2,700 |     | 2,700 |     | 2,700 |         | 2,700 |     | 2,700 |     | 2,700 |     | 2,700 |     | 2,700 |     | 2,700 |     | 2,700   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038 | 9   | 0   | 1   | 2   | 2043 | 4   | 5   | 6   | 7   | 2048 | 9   | 0 | 1   | 2   | 2053 | 4   | 5   | 6   | 7   | 2058 | 9   | 0   | 1   | 2   |     |        |
|--|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|---|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|--------|
| Install New Gasket & Bolts, Pipe & Fittings, 2" Steel    |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     | 623 |        |
| Replace Fire Suppression System Water Pump, 10 HP        |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 5,856  |
| Maintain Fire Suppression System Water Pump, 10 HP       | 432  | 432 | 432 | 432 | 432 | 432  | 432 | 432 | 432 | 432 | 432  | 432 |   | 432 | 432 | 432  | 432 | 432 | 432 | 432 | 432  | 432 | 432 | 432 | 432 | 432 |        |
| Inspect & Test Fire Suppression System Water Pump, 10 HP | 189  | 189 | 189 | 189 | 189 | 189  | 189 | 189 | 189 | 189 | 189  | 189 |   | 189 | 189 | 189  | 189 | 189 | 189 | 189 | 189  | 189 | 189 | 189 | 189 | 189 |        |
| Test Gages & Valves, Fire Sprinkler System               | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 |   | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757  | 757 | 757 | 757 | 757 | 757 |        |
| Maintain Fire Sprinkler System                           | 821  | 821 | 821 | 821 | 821 | 821  | 821 | 821 | 821 | 821 | 821  | 821 |   | 821 | 821 | 821  | 821 | 821 | 821 | 821 | 821  | 821 | 821 | 821 | 821 | 821 |        |
| Replace Fire Sprinkler Head                              |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 40,599 |
| Test Fire Sprinkler Head                                 |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 18,605 |
| Inspect Fire Sprinkler Head                              | 373  | 373 | 373 | 373 | 373 | 373  | 373 | 373 | 373 | 373 | 373  | 373 |   | 373 | 373 | 373  | 373 | 373 | 373 | 373 | 373  | 373 | 373 | 373 | 373 | 373 |        |
| Replace Fire Alarm Control Panel                         |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 3,219  |
| Repair Fire Alarm Control Panel                          |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 122    |
| Inspect & Test Fire Alarm Control Panel                  | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 |   | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131  | 131 | 131 | 131 | 131 | 131 |        |
| Replace Valves & Components, Sprinkler System            |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 51,645 |
| Replace 10' Section, Pipe & Fittings, 4" Steel           |      |     |     |     |     |      |     |     |     |     |      |     |   |     |     |      |     |     |     |     |      |     |     |     |     |     | 64     |

## D50 Electrical

|   |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       |         |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|---------|
| Replace Exit Lighting Fixture, w/ Battery                     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     | 4,199 |         |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 2- |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 29,822  |
| Replace Ballast & Lamps, Fluorescent Lighting Fixture, T8, 4- |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 58,647  |
| Replace Fluorescent Lighting Fixture, T8, 2-32 w              |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 47,682  |
| Replace Fluorescent Lighting Fixture, T8, 4-32 w              |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 93,770  |
| Replace Lamp, LED Lighting Fixture, 100 w                     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 813     |
| Replace LED Lighting Fixture, 100 w                           |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 2,354   |
| Replace Ballast & Lamp, HP Sodium Lighting Fixture, 250 w     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 5,267   |
| Replace HP Sodium Lighting Fixture, 250 w                     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 14,923  |
| Replace Lamp, Exit Lighting Fixture, w/ Battery               |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 921     |
| Replace Incandescent Lighting Fixture, Basic, 100 w           |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 1,455   |
| Replace Ballast & Lamps, Compact Fluorescent Lighting Fixtu   |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 1,922   |
| Replace Receptacle, 120 V, 20 Amp.                            |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 149,616 |
| Replace Lamp, Incandescent Lighting Fixture, Basic, 100 w     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 96      |
| Inspect & Clean Variable Frequency Drive, <600 V              | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 |  | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184   |         |
| Maintain Switchboard, 1600 Amp.                               | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 |  | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102   |         |
| Replace Switchboard, 1600 Amp.                                |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       |         |
| Inspect & Clean Transfer Switch, Auto, 600 V, 150 Amp.        | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  |  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21    |         |
| Repair Transfer Switch, Auto, 600 V, 150 Amp.                 | 214 |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 214     |
| Replace Transfer Switch, Auto, 600 V, 150 Amp.                |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 7,443   |
| Inspect & Clean Transfer Switch, Auto, 600 V, 1,600 Amp.      | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  |  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21  | 21    |         |
| Replace Lamp, Replace Emergency Lighting Pack, 2 Light w/     |     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |       | 2,700   |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2013  | 4     | 5      | 6     | 7     | 2018  | 9     | 0      | 1     | 2     | 2023   | 4     | 5      | 6      | 7     | 2028  | 9     | 0       | 1     | 2      | 2033   | 4     | 5      | 6     | 7     |
|---|-------|-------|--------|-------|-------|-------|-------|--------|-------|-------|--------|-------|--------|--------|-------|-------|-------|---------|-------|--------|--------|-------|--------|-------|-------|
| Replace Transfer Switch, Auto, 600 V, 1,600 Amp.              |       |       |        |       |       |       |       |        |       |       | 34,372 |       |        |        |       |       |       |         |       |        |        |       |        |       |       |
| Replace Emergency Lighting Pack, 2 Light w/ Battery           |       |       |        |       |       |       |       |        |       |       |        |       | 43,015 |        |       |       |       |         |       |        |        |       |        |       |       |
| Replace Coil, Variable Frequency Drive, <600V                 |       |       | 427    |       |       |       |       | 427    |       |       |        |       |        |        |       | 427   |       |         |       |        | 427    |       |        |       |       |
| Replace Variable Frequency Drive, <600V                       |       |       |        |       |       |       |       |        |       |       | 43,900 |       |        |        |       |       |       |         |       |        |        |       |        |       |       |
| Replace Camera, Exterior, Closed Circuit, PTZ Color           |       |       | 24,447 |       |       |       |       |        |       |       |        |       | 24,447 |        |       |       |       |         |       |        |        |       | 24,447 |       |       |
| Replace Compact Fluorescent Lighting Fixture, 32 w            |       |       |        |       |       |       |       |        |       |       |        |       | 2,169  |        |       |       |       |         |       |        |        |       |        |       |       |
| Replace Receptacle, 208 V, 3 phase                            |       |       |        |       |       |       |       |        |       |       |        |       | 968    |        |       |       |       |         |       |        |        |       |        |       |       |
| Replace Lens, Replace Emergency Lighting Pack, 2 Light w/ Ba  |       |       | 1,331  |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 1,331  |       |       |
| Repair Transfer Switch, Auto, 600 V, 1,600 Amp.               |       |       | 195    |       |       |       |       | 195    |       |       |        |       |        |        |       | 195   |       |         |       |        | 195    |       |        |       |       |
| Replace Generator, Diesel, 500 kw                             |       |       |        |       |       |       |       |        |       |       |        |       |        |        |       |       |       | 195,175 |       |        |        |       |        |       |       |
| Replace Motion Detector                                       |       |       | 13,202 |       |       |       |       |        |       |       |        |       | 13,202 |        |       |       |       |         |       |        |        |       | 13,202 |       |       |
| Replace Batteries & Check Operation, Smoke Detector, Duct     | 538   | 538   | 538    | 538   | 538   | 538   | 538   |        | 538   | 538   | 538    | 538   | 538    | 538    | 538   | 538   | 538   | 538     | 538   | 538    | 538    | 538   | 538    | 538   | 538   |
| Repair Smoke Detector   |       |       | 1,988  |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        | 1,988  |       |        |       |       |
| Repair Smoke Detector, Duct                                   |       |       | 1,185  |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        | 1,185  |       |        |       |       |
| Replace Smoke Detector  |       |       |        |       |       |       |       | 7,377  |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 7,377  |       |       |
| Replace Public Address Speaker                                |       |       |        |       |       |       |       | 31,027 |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 31,027 |       |       |
| Electrical Testing, Generator, Diesel, 500 kw                 | 733   | 733   | 733    | 733   | 733   | 733   | 733   | 733    | 733   | 733   | 733    | 733   | 733    | 733    | 733   | 733   | 733   |         |       | 733    | 733    | 733   | 733    | 733   | 733   |
| Maintain Public Address Speaker                               | 2,137 | 2,137 | 2,137  | 2,137 | 2,137 | 2,137 | 2,137 |        | 2,137 | 2,137 | 2,137  | 2,137 | 2,137  | 2,137  | 2,137 | 2,137 | 2,137 | 2,137   | 2,137 | 2,137  | 2,137  | 2,137 | 2,137  | 2,137 | 2,137 |
| Maintain & Repair General Wiring, Lightning Protection System | 189   | 189   | 189    | 189   | 189   | 189   | 189   | 189    | 189   | 189   | 189    | 189   | 189    | 189    | 189   | 189   | 189   |         |       | 189    | 189    | 189   | 189    | 189   | 189   |
| Annual PM, Grounding System                                   | 138   | 138   | 138    | 138   | 138   | 138   | 138   | 138    | 138   | 138   | 138    | 138   | 138    | 138    | 138   | 138   | 138   |         |       | 138    | 138    | 138   | 138    | 138   | 138   |
| Maintain & Repair, Grounding System                           | 136   | 136   | 136    | 136   | 136   | 136   | 136   | 136    | 136   | 136   | 136    | 136   | 136    | 136    | 136   | 136   | 136   |         |       | 136    | 136    | 136   | 136    | 136   | 136   |
| Maintain Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.        | 25    | 25    | 25     | 25    | 25    | 25    | 25    | 25     | 25    | 25    | 25     | 25    | 25     | 25     | 25    | 25    | 25    | 25      | 25    | 25     | 25     | 25    | 25     | 25    | 25    |
| Replace Lightning Protection General Wiring                   |       |       |        |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        | 28,000 |       |        |       |       |
| Replace Secondary Transformer, Dry, 300 kVA                   |       |       |        |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 43,856 |       |       |
| Replace Smoke Detector, Duct                                  |       |       |        |       |       |       |       | 14,334 |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 14,334 |       |       |
| Maintain Card Reader  | 2,567 | 2,567 |        | 2,567 | 2,567 | 2,567 | 2,567 | 2,567  | 2,567 | 2,567 | 2,567  | 2,567 |        | 2,567  | 2,567 | 2,567 | 2,567 | 2,567   | 2,567 | 2,567  | 2,567  | 2,567 | 2,567  | 2,567 | 2,567 |
| Replace Wiring Device, Switch                                 |       |       |        |       |       |       |       | 16,942 |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 16,942 |       |       |
| Annual PM, Motion Detector                                    | 129   | 129   |        | 129   | 129   | 129   | 129   | 129    | 129   | 129   | 129    | 129   |        | 129    | 129   | 129   | 129   | 129     | 129   | 129    | 129    | 129   | 129    | 129   | 129   |
| Maintain Camera, Exterior, Closed Circuit, PTZ Color          | 306   | 306   |        | 306   | 306   | 306   | 306   | 306    | 306   | 306   | 306    | 306   |        | 306    | 306   | 306   | 306   | 306     | 306   | 306    | 306    | 306   | 306    | 306   | 306   |
| Maintain Camera, Interior, Closed Circuit, Fixed Color        | 367   | 367   |        | 367   | 367   | 367   | 367   | 367    | 367   | 367   | 367    | 367   |        | 367    | 367   | 367   | 367   | 367     | 367   | 367    | 367    | 367   | 367    | 367   | 367   |
| Replace Camera, Interior, Closed Circuit, Fixed Color         |       |       | 11,261 |       |       |       |       |        |       |       |        |       | 11,261 |        |       |       |       |         |       |        |        |       | 11,261 |       |       |
| Replace Batteries & Check Operation, Smoke Detector           | 902   | 902   | 902    | 902   | 902   | 902   | 902   |        | 902   | 902   | 902    | 902   | 902    | 902    | 902   | 902   | 902   | 902     | 902   | 902    | 902    | 902   | 902    | 902   | 902   |
| Replace Camera, Interior, Closed Circuit, PTZ Color           |       |       | 43,780 |       |       |       |       |        |       |       |        |       | 43,780 |        |       |       |       |         |       |        |        |       | 43,780 |       |       |
| Repair Wiring Device, Switch                                  |       |       | 16,103 |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       | 16,103 |        |       |        |       |       |
| Replace Card Reader   |       |       | 39,036 |       |       |       |       |        |       |       |        |       |        | 39,036 |       |       |       |         |       |        |        |       | 39,036 |       |       |
| Replace Electric Lock   |       |       | 11,267 |       |       |       |       |        |       |       |        |       |        |        |       |       |       |         |       |        |        |       | 11,267 |       |       |
| Replace Fire Alarm Horn & Strobe                              |       |       |        |       |       |       |       |        |       |       |        |       |        | 14,211 |       |       |       |         |       |        |        |       |        |       |       |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2038  | 9     | 0     | 1     | 2     | 2043   | 4     | 5     | 6      | 7     | 2048  | 9     | 0     | 1     | 2     | 2053  | 4     | 5     | 6       | 7      | 2058  | 9     | 0     | 1     | 2      |        |
|--|-------|-------|-------|-------|-------|--------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|--------|-------|-------|-------|-------|--------|--------|
| Replace Transfer Switch, Auto, 600 V, 1,600 Amp.             |       |       |       |       |       | 34,372 |       |       |        |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       | 34,372 |        |
| Replace Emergency Lighting Pack, 2 Light w/ Battery          |       |       |       |       |       |        |       |       | 43,015 |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        |        |
| Replace Coil, Variable Frequency Drive, <600V                | 427   |       |       |       |       |        |       |       | 427    |       |       |       |       | 427   |       |       |       |       |         | 427    |       |       |       |       |        |        |
| Replace Variable Frequency Drive, <600V                      |       |       |       |       |       | 43,900 |       |       |        |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        | 43,900 |
| Replace Camera, Exterior, Closed Circuit, PTZ Color          |       |       |       |       |       |        |       |       | 24,447 |       |       |       |       |       |       |       |       |       | 24,447  |        |       |       |       |       |        |        |
| Replace Compact Fluorescent Lighting Fixture, 32 w           |       |       |       |       |       |        |       |       | 2,169  |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        |        |
| Replace Receptacle, 208 V, 3 phase                           |       |       |       |       |       |        |       |       | 968    |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        |        |
| Replace Lens, Replace Emergency Lighting Pack, 2 Light w/    |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       | 1,331   |        |       |       |       |       |        |        |
| Repair Transfer Switch, Auto, 600 V, 1,600 Amp.              | 195   |       |       |       |       |        |       |       | 195    |       |       |       |       | 195   |       |       |       |       |         | 195    |       |       |       |       |        |        |
| Replace Generator, Diesel, 500 kw                            |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       | 195,175 |        |       |       |       |       |        |        |
| Replace Motion Detector                                      |       |       |       |       |       |        |       |       | 13,202 |       |       |       |       |       |       |       |       |       | 13,202  |        |       |       |       |       |        |        |
| Replace Batteries & Check Operation, Smoke Detector, Duct    | 538   | 538   | 538   | 538   | 538   | 538    | 538   | 538   | 538    | 538   | 538   | 538   | 538   | 538   | 538   | 538   | 538   | 538   | 538     | 538    | 538   | 538   | 538   | 538   | 538    | 538    |
| Repair Smoke Detector  |       |       |       |       |       |        |       |       | 1,988  |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        | 1,988  |
| Repair Smoke Detector, Duct                                  |       |       |       |       |       |        |       |       | 1,185  |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        | 1,185  |
| Replace Smoke Detector                                       |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       | 7,377   |        |       |       |       |       |        |        |
| Replace Public Address Speaker                               |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       | 31,027  |        |       |       |       |       |        |        |
| Electrical Testing, Generator, Diesel, 500 kw                | 733   | 733   | 733   | 733   | 733   | 733    | 733   | 733   | 733    | 733   | 733   | 733   | 733   | 733   | 733   | 733   | 733   | 733   |         | 733    | 733   | 733   | 733   | 733   | 733    | 733    |
| Maintain Public Address Speaker                              | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137  | 2,137 | 2,137 | 2,137  | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137 | 2,137   | 2,137  | 2,137 | 2,137 | 2,137 | 2,137 | 2,137  | 2,137  |
| Maintain & Repair General Wiring, Lightning Protection Syste | 189   | 189   | 189   | 189   | 189   | 189    | 189   | 189   | 189    | 189   | 189   | 189   | 189   | 189   | 189   | 189   | 189   | 189   |         | 189    | 189   | 189   | 189   | 189   | 189    | 189    |
| Annual PM, Grounding System                                  | 138   | 138   | 138   | 138   | 138   | 138    | 138   | 138   | 138    | 138   | 138   | 138   | 138   | 138   | 138   | 138   | 138   | 138   |         | 138    | 138   | 138   | 138   | 138   | 138    | 138    |
| Maintain & Repair, Grounding System                          | 136   | 136   | 136   | 136   | 136   | 136    | 136   | 136   | 136    | 136   | 136   | 136   | 136   | 136   | 136   | 136   | 136   | 136   |         | 136    | 136   | 136   | 136   | 136   | 136    | 136    |
| Maintain Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.       | 25    | 25    | 25    | 25    | 25    | 25     | 25    | 25    | 25     | 25    | 25    | 25    | 25    | 25    | 25    | 25    | 25    | 25    |         | 25     | 25    | 25    | 25    | 25    | 25     | 25     |
| Replace Lightning Protection General Wiring                  |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       |         | 28,000 |       |       |       |       |        |        |
| Replace Secondary Transformer, Dry, 300 kVA                  |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        |        |
| Replace Smoke Detector, Duct                                 |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       |         | 14,334 |       |       |       |       |        |        |
| Maintain Card Reader   | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 | 2,567  | 2,567 |       | 2,567  | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 | 2,567 |         | 2,567  | 2,567 | 2,567 | 2,567 | 2,567 | 2,567  | 2,567  |
| Replace Wiring Device, Switch                                |       |       |       |       |       |        |       |       |        |       |       |       |       |       |       |       |       |       |         | 16,942 |       |       |       |       |        |        |
| Annual PM, Motion Detector                                   | 129   | 129   | 129   | 129   | 129   | 129    | 129   |       | 129    | 129   | 129   | 129   | 129   | 129   | 129   | 129   | 129   | 129   |         | 129    | 129   | 129   | 129   | 129   | 129    | 129    |
| Maintain Camera, Exterior, Closed Circuit, PTZ Color         | 306   | 306   | 306   | 306   | 306   | 306    | 306   |       | 306    | 306   | 306   | 306   | 306   | 306   | 306   | 306   | 306   | 306   |         | 306    | 306   | 306   | 306   | 306   | 306    | 306    |
| Maintain Camera, Interior, Closed Circuit, Fixed Color       | 367   | 367   | 367   | 367   | 367   | 367    | 367   |       | 367    | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   |         | 367    | 367   | 367   | 367   | 367   | 367    | 367    |
| Replace Camera, Interior, Closed Circuit, Fixed Color        |       |       |       |       |       |        |       |       | 11,261 |       |       |       |       |       |       |       |       |       |         | 11,261 |       |       |       |       |        |        |
| Replace Batteries & Check Operation, Smoke Detector          | 902   | 902   | 902   | 902   | 902   | 902    | 902   | 902   | 902    | 902   | 902   | 902   | 902   | 902   | 902   | 902   | 902   | 902   | 902     |        | 902   | 902   | 902   | 902   | 902    | 902    |
| Replace Camera, Interior, Closed Circuit, PTZ Color          |       |       |       |       |       |        |       |       | 43,780 |       |       |       |       |       |       |       |       |       |         | 43,780 |       |       |       |       |        |        |
| Repair Wiring Device, Switch                                 |       |       |       |       |       |        |       |       | 16,103 |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        | 16,103 |
| Replace Card Reader  |       |       |       |       |       |        |       |       | 39,036 |       |       |       |       |       |       |       |       |       |         | 39,036 |       |       |       |       |        |        |
| Replace Electric Lock  |       |       |       |       |       |        |       |       | 11,267 |       |       |       |       |       |       |       |       |       |         | 11,267 |       |       |       |       |        |        |
| Replace Fire Alarm Horn & Strobe                             |       |       |       |       |       |        |       |       | 14,211 |       |       |       |       |       |       |       |       |       |         |        |       |       |       |       |        |        |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:   | 2013  | 4     | 5     | 6     | 7     | 2018  | 9     | 0     | 1     | 2     | 2023  | 4     | 5     | 6      | 7     | 2028  | 9     | 0     | 1     | 2     | 2033  | 4     | 5     | 6     | 7     |     |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| Replace Fire Alarm Strobe                                    |       |       |       |       |       |       |       |       |       |       |       |       | 4,573 |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Check & Repair Manual Pull Station                           |       |       | 1,153 |       |       |       |       |       |       |       |       |       |       |        |       |       |       | 1,153 |       |       |       |       |       |       |       |     |
| Replace Manual Pull Station                                  |       |       |       |       |       |       |       |       |       |       | 2,667 |       |       |        |       |       |       |       |       |       |       |       |       | 2,667 |       |     |
| Maintain Camera, Interior, Closed Circuit, PTZ Color         | 855   | 855   |       | 855   | 855   | 855   | 855   | 855   | 855   | 855   | 855   | 855   |       | 855    | 855   | 855   | 855   | 855   | 855   | 855   | 855   | 855   |       | 855   | 855   |     |
| Replace Disconnect Switch, 100 Amp.                          |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Replace Motor Starter, 5-20 HP, <600 V                       |       |       |       |       |       |       |       |       |       |       | 4,355 |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Replace Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.        |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Inspect & Clean Motor Starter, 5-20 HP, <600 V               | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   |       | 245   | 245   | 245    | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245 |
| Replace Motor Starter, <5HP, <600V                           |       |       |       |       |       |       |       |       |       |       | 569   |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Replace Coil, Motor Starter, <5HP, <600V                     |       | 201   |       |       | 201   |       |       | 201   |       |       |       |       |       | 201    |       |       | 201   |       |       | 201   |       |       |       | 201   |       |     |
| Inspect & Clean Motor Starter, <5HP, <600V                   | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    |       | 41    | 41    | 41     | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41  |
| Replace Motor Control Center w/ Main Breaker, 480 V, 600 Am  |       |       |       |       |       |       |       |       |       |       |       |       |       | 83,294 |       |       |       |       |       |       |       |       |       |       |       |     |
| Repair Motor Control Center w/ Main Breaker, 480 V, 600 Amp. |       |       | 3,963 |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 3,963 |       |     |
| Maintain Motor Control Center w/ Main Breaker, 480 V, 600 Am | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   |        | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367 |
| Replace Disconnect Switch, 400 Amp.                          |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Repair Disconnect Switch, 400 Amp.                           |       |       | 234   |       |       |       |       |       |       |       |       |       |       | 234    |       |       |       |       |       |       |       |       |       | 234   |       |     |
| Maintain Disconnect Switch, 400 Amp.                         | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57     | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57  |
| Replace Disconnect Switch, 200 Amp.                          |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Repair Secondary Transformer, Dry, 300 kVA                   |       |       | 947   |       |       |       |       |       |       |       |       |       |       | 947    |       |       |       |       |       |       |       |       |       |       |       |     |
| Replace Disconnect Switch, 30 Amp.                           |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Replace TVSS Panel   |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 3,424 |       |     |
| Repair Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.         |       |       | 690   |       |       |       |       |       |       |       |       |       |       | 690    |       |       |       |       |       |       |       |       |       | 690   |       |     |
| Maintain Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.         | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49     | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49  |
| Repair Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.           |       |       | 881   |       |       |       |       |       |       |       |       |       |       | 881    |       |       |       |       |       |       |       |       |       | 881   |       |     |
| Replace Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.          |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Repair Disconnect Switch, 200 Amp.                           |       |       | 778   |       |       |       |       |       |       |       |       |       |       | 778    |       |       |       |       |       |       |       |       |       | 778   |       |     |
| Repair Disconnect Switch, 30 Amp.                            |       |       | 5,747 |       |       |       |       |       |       |       |       |       |       | 5,747  |       |       |       |       |       |       |       |       |       | 5,747 |       |     |
| Maintain Disconnect Switch, 200 Amp.                         | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284    | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284 |
| Maintain Disconnect Switch, 60 Amp.                          | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585    | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585 |
| Repair Disconnect Switch, 60 Amp.                            |       |       | 3,805 |       |       |       |       |       |       |       |       |       |       | 3,805  |       |       |       |       |       |       |       |       |       | 3,805 |       |     |
| Replace Disconnect Switch, 60 Amp.                           |       |       |       |       |       |       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |       |       |     |
| Maintain Disconnect Switch, 100 Amp.                         | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455    | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455 |
| Repair Disconnect Switch, 100 Amp.                           |       |       | 1,207 |       |       |       |       |       |       |       |       |       |       | 1,207  |       |       |       |       |       |       |       |       |       | 1,207 |       |     |
| Maintain Power Panel Board, 208 Y/120 V, 100 Amp.            | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956  | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 |     |
| Maintain Disconnect Switch, 30 Amp.                          | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907    | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907 |
| Repair Power Panel Board, 480 V, 400 Amp.                    |       |       | 951   |       |       |       |       |       |       |       |       |       |       | 951    |       |       |       |       |       |       |       |       |       | 951   |       |     |
| Maintain Secondary Transformer, Dry, 300 kVA                 | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122    | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   |     |

# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:  | 2038  | 9     | 0     | 1     | 2     | 2043  | 4     | 5      | 6     | 7     | 2048  | 9     | 0     | 1     | 2     | 2053  | 4     | 5      | 6      | 7     | 2058  | 9     | 0     | 1     | 2     |
|---|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|-------|-------|-------|-------|-------|
| Replace Fire Alarm Strobe                                   |       |       |       |       |       |       |       | 4,573  |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Check & Repair Manual Pull Station                          |       |       |       |       |       |       |       | 1,153  |       |       |       |       |       |       |       |       |       |        |        |       |       |       | 1,153 |       |       |
| Replace Manual Pull Station                                 |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       | 2,667 |       |        |        |       |       |       |       |       |       |
| Maintain Camera, Interior, Closed Circuit, PTZ Color        | 855   | 855   | 855   | 855   | 855   | 855   | 855   |        | 855   | 855   | 855   | 855   | 855   | 855   | 855   | 855   | 855   |        | 855    | 855   | 855   | 855   | 855   | 855   | 855   |
| Replace Disconnect Switch, 100 Amp.                         |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       | 10,373 |        |       |       |       |       |       |       |
| Replace Motor Starter, 5-20 HP, <600 V                      |       |       |       |       |       | 4,355 |       |        |       |       |       |       |       |       |       |       |       |        |        |       |       |       | 4,355 |       |       |
| Replace Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.       |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 4,777  |       |       |       |       |       |       |
| Inspect & Clean Motor Starter, 5-20 HP, <600 V              | 245   | 245   | 245   |       | 245   | 245   | 245   | 245    | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245   | 245    | 245    | 245   | 245   |       | 245   | 245   | 245   |
| Replace Motor Starter, <5HP, <600V                          |       |       |       |       |       | 569   |       |        |       |       |       |       |       |       |       |       |       |        |        |       |       |       | 569   |       |       |
| Replace Coil, Motor Starter, <5HP, <600V                    | 201   |       |       |       |       |       | 201   |        |       | 201   |       |       |       | 201   |       |       |       |        | 201    |       |       | 201   |       |       | 201   |
| Inspect & Clean Motor Starter, <5HP, <600V                  | 41    | 41    | 41    |       | 41    | 41    | 41    | 41     | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41    | 41     | 41     | 41    | 41    |       | 41    | 41    | 41    |
| Replace Motor Control Center w/ Main Breaker, 480 V, 600 A  |       |       |       |       |       |       |       | 83,294 |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Repair Motor Control Center w/ Main Breaker, 480 V, 600 Am  |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 3,963  |       |       |       |       |       |       |
| Maintain Motor Control Center w/ Main Breaker, 480 V, 600 A | 367   | 367   | 367   | 367   | 367   | 367   | 367   |        | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367   | 367    | 367    | 367   | 367   | 367   | 367   | 367   | 367   |
| Replace Disconnect Switch, 400 Amp.                         |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 4,270  |       |       |       |       |       |       |
| Repair Disconnect Switch, 400 Amp.                          |       |       |       |       |       |       |       | 234    |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Maintain Disconnect Switch, 400 Amp.                        | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57     | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    | 57    |        | 57     | 57    | 57    | 57    | 57    | 57    | 57    |
| Replace Disconnect Switch, 200 Amp.                         |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 6,803  |       |       |       |       |       |       |
| Repair Secondary Transformer, Dry, 300 kVA                  |       |       |       |       |       |       |       |        | 947   |       |       |       |       |       |       |       |       |        | 947    |       |       |       |       |       |       |
| Replace Disconnect Switch, 30 Amp.                          |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 15,685 |       |       |       |       |       |       |
| Replace TVSS Panel  |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Repair Circuit Breaker, Main, 208 Y, 120 V, 400 Amp.        |       |       |       |       |       |       |       | 690    |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Maintain Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.        | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49     | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    | 49    |        | 49     | 49    | 49    | 49    | 49    | 49    | 49    |
| Repair Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.          |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 881    |       |       |       |       |       |       |
| Replace Circuit Breaker, 600 V, 125-400 Amp., 3 Ph.         |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        |        | 8,301 |       |       |       |       |       |
| Repair Disconnect Switch, 200 Amp.                          |       |       |       |       |       |       |       |        | 778   |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Repair Disconnect Switch, 30 Amp.                           |       |       |       |       |       |       |       | 5,747  |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Maintain Disconnect Switch, 200 Amp.                        | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284    | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   | 284   |        | 284    | 284   | 284   | 284   | 284   | 284   | 284   |
| Maintain Disconnect Switch, 60 Amp.                         | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585    | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   | 585   |        | 585    | 585   | 585   | 585   | 585   | 585   | 585   |
| Repair Disconnect Switch, 60 Amp.                           |       |       |       |       |       |       |       | 3,805  |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Replace Disconnect Switch, 60 Amp.                          |       |       |       |       |       |       |       |        |       |       |       |       |       |       |       |       |       |        | 22,657 |       |       |       |       |       |       |
| Maintain Disconnect Switch, 100 Amp.                        | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455    | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   | 455   |        | 455    | 455   | 455   | 455   | 455   | 455   | 455   |
| Repair Disconnect Switch, 100 Amp.                          |       |       |       |       |       |       |       | 1,207  |       |       |       |       |       |       |       |       |       |        |        |       |       |       |       |       |       |
| Maintain Power Panel Board, 208 Y/120 V, 100 Amp.           | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956  | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 |        | 1,956  | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 | 1,956 |
| Maintain Disconnect Switch, 30 Amp.                         | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907    | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   | 907   |        | 907    | 907   | 907   | 907   | 907   | 907   | 907   |
| Repair Power Panel Board, 480 V, 400 Amp.                   |       |       |       |       |       |       |       | 951    |       |       |       |       |       |       |       |       |       |        | 951    |       |       |       |       |       |       |
| Maintain Secondary Transformer, Dry, 300 kVA                | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122    | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   | 122   |        | 122    | 122   | 122   | 122   | 122   | 122   | 122   |



# M&R Costs by Task

Whitestone Research

05-Mar-13

**Building:** Propulsion Research & Development **Facility:** Marshall Space Flight Center

**Building Num:** 1045/62/346

**City:** Huntsville, AL

| Forecast Year:                                    | 2013 | 4     | 5     | 6   | 7     | 2018 | 9   | 0     | 1   | 2   | 2023 | 4   | 5   | 6     | 7   | 2028 | 9     | 0   | 1   | 2     | 2033 | 4   | 5   | 6   | 7   |         |  |
|---|------|-------|-------|-----|-------|------|-----|-------|-----|-----|------|-----|-----|-------|-----|------|-------|-----|-----|-------|------|-----|-----|-----|-----|---------|--|
| Replace Secondary Transformer, Dry, 225 kVA       |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 29,888  |  |
| Repair Secondary Transformer, Dry, 225 kVA        |      |       | 794   |     |       |      |     |       |     |     |      |     |     | 794   |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Maintain Secondary Transformer, Dry, 225 kVA      | 122  | 122   | 122   | 122 | 122   | 122  | 122 | 122   | 122 | 122 | 122  | 122 | 122 | 122   | 122 | 122  | 122   | 122 | 122 | 122   | 122  | 122 | 122 | 122 | 122 | 122     |  |
| Replace Secondary Transformer, Dry, 30 kVA        |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 9,531   |  |
| Repair Secondary Transformer, Dry, 30 kVA         |      |       | 566   |     |       |      |     |       |     |     |      |     |     | 566   |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Maintain Secondary Transformer, Dry, 30 kVA       | 122  | 122   | 122   | 122 | 122   | 122  | 122 | 122   | 122 | 122 | 122  | 122 | 122 | 122   | 122 | 122  | 122   | 122 | 122 | 122   | 122  | 122 | 122 | 122 | 122 | 122     |  |
| Replace Secondary Transformer, Dry, 15 kVA        |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 4,038   |  |
| Repair Secondary Transformer, Dry, 15 kVA         |      |       | 283   |     |       |      |     |       |     |     |      |     |     | 283   |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Maintain Secondary Transformer, Dry, 15 kVA       | 62   | 62    | 62    | 62  | 62    | 62   | 62  | 62    | 62  | 62  | 62   | 62  | 62  | 62    | 62  | 62   | 62    | 62  | 62  | 62    | 62   | 62  | 62  | 62  | 62  | 62      |  |
| Replace Power Panel Board, 480 V, 1,000 Amp.      |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 55,116  |  |
| Repair Power Panel Board, 480 V, 1,000 Amp.       |      |       | 2,894 |     |       |      |     |       |     |     |      |     |     | 2,894 |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Replace Coil, Motor Starter, 5-20 HP, <600 V      |      | 1,206 |       |     | 1,206 |      |     | 1,206 |     |     |      |     |     | 1,206 |     |      | 1,206 |     |     | 1,206 |      |     |     |     |     | 1,206   |  |
| Replace Power Panel Board, 480 V, 400 Amp.        |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 66,704  |  |
| Replace Power Panel Board, 208 Y/120 V, 400 Amp.  |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 98,691  |  |
| Replace Power Panel Board, 208 Y/120 V, 100 Amp.  |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 133,418 |  |
| Maintain Power Panel Board, 208 Y/120 V, 225 Amp. | 550  | 550   | 550   | 550 | 550   | 550  | 550 | 550   | 550 | 550 | 550  | 550 | 550 | 550   | 550 | 550  | 550   | 550 | 550 | 550   | 550  | 550 | 550 | 550 | 550 | 550     |  |
| Repair Power Panel Board, 208 Y/120 V, 225 Amp.   |      |       | 882   |     |       |      |     |       |     |     |      |     |     | 882   |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Replace Power Panel Board, 208 Y/120 V, 225 Amp.  |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 57,460  |  |
| Maintain Power Panel Board, 480 V, 1,000 Amp.     | 245  | 245   | 245   | 245 | 245   | 245  | 245 | 245   | 245 | 245 | 245  | 245 | 245 | 245   | 245 | 245  | 245   | 245 | 245 | 245   | 245  | 245 | 245 | 245 | 245 | 245     |  |
| Repair Power Panel Board, 208 Y/120 V, 400 Amp.   |      |       | 1,274 |     |       |      |     |       |     |     |      |     |     | 1,274 |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Repair Power Panel Board, 208 Y/120 V, 100 Amp.   |      |       | 3,137 |     |       |      |     |       |     |     |      |     |     | 3,137 |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Maintain Power Panel Board, 480 V, 100 Amp.       | 550  | 550   | 550   | 550 | 550   | 550  | 550 | 550   | 550 | 550 | 550  | 550 | 550 | 550   | 550 | 550  | 550   | 550 | 550 | 550   | 550  | 550 | 550 | 550 | 550 | 550     |  |
| Repair Power Panel Board, 480 V, 100 Amp.         |      |       | 882   |     |       |      |     |       |     |     |      |     |     | 882   |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Replace Power Panel Board, 480 V, 100 Amp.        |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 52,939  |  |
| Maintain Power Panel Board, 480 V, 200 Amp.       | 673  | 673   | 673   | 673 | 673   | 673  | 673 | 673   | 673 | 673 | 673  | 673 | 673 | 673   | 673 | 673  | 673   | 673 | 673 | 673   | 673  | 673 | 673 | 673 | 673 | 673     |  |
| Repair Power Panel Board, 480 V, 200 Amp.         |      |       | 1,078 |     |       |      |     |       |     |     |      |     |     | 1,078 |     |      |       |     |     |       |      |     |     |     |     |         |  |
| Replace Power Panel Board, 480 V, 200 Amp.        |      |       |       |     |       |      |     |       |     |     |      |     |     |       |     |      |       |     |     |       |      |     |     |     |     | 89,767  |  |
| Maintain Power Panel Board, 480 V, 400 Amp.       | 428  | 428   | 428   | 428 | 428   | 428  | 428 | 428   | 428 | 428 | 428  | 428 | 428 | 428   | 428 | 428  | 428   | 428 | 428 | 428   | 428  | 428 | 428 | 428 | 428 | 428     |  |
| Maintain Power Panel Board, 208 Y/120 V, 400 Amp. | 795  | 795   | 795   | 795 | 795   | 795  | 795 | 795   | 795 | 795 | 795  | 795 | 795 | 795   | 795 | 795  | 795   | 795 | 795 | 795   | 795  | 795 | 795 | 795 | 795 | 795     |  |

## E10 Equipment

|                                      |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |        |
|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| Replace Laboratory Exhaust Hood, 6'  |     |     |     |     |     |     |     |  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 18,219 |
| Maintain Laboratory Exhaust Hood, 6' | 380 | 380 | 380 | 380 | 380 | 380 | 380 |  | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380    |

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**City:** Huntsville, AL

| Forecast Year:                                    | 2038  | 9   | 0   | 1   | 2   | 2043  | 4   | 5     | 6   | 7     | 2048 | 9   | 0   | 1     | 2   | 2053 | 4   | 5     | 6     | 7   | 2058 | 9   | 0   | 1   | 2     |
|---|-------|-----|-----|-----|-----|-------|-----|-------|-----|-------|------|-----|-----|-------|-----|------|-----|-------|-------|-----|------|-----|-----|-----|-------|
| Replace Secondary Transformer, Dry, 225 kVA       |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Repair Secondary Transformer, Dry, 225 kVA        |       |     |     |     |     |       |     | 794   |     |       |      |     |     |       |     |      |     | 794   |       |     |      |     |     |     |       |
| Maintain Secondary Transformer, Dry, 225 kVA      | 122   | 122 | 122 | 122 | 122 | 122   | 122 | 122   | 122 | 122   | 122  | 122 | 122 | 122   | 122 | 122  | 122 | 122   | 122   | 122 | 122  | 122 | 122 | 122 | 122   |
| Replace Secondary Transformer, Dry, 30 kVA        |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Repair Secondary Transformer, Dry, 30 kVA         |       |     |     |     |     |       |     | 566   |     |       |      |     |     |       |     |      |     | 566   |       |     |      |     |     |     |       |
| Maintain Secondary Transformer, Dry, 30 kVA       | 122   | 122 | 122 | 122 | 122 | 122   | 122 | 122   | 122 | 122   | 122  | 122 | 122 | 122   | 122 | 122  | 122 | 122   | 122   | 122 | 122  | 122 | 122 | 122 | 122   |
| Replace Secondary Transformer, Dry, 15 kVA        |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Repair Secondary Transformer, Dry, 15 kVA         |       |     |     |     |     |       |     | 283   |     |       |      |     |     |       |     |      |     | 283   |       |     |      |     |     |     |       |
| Maintain Secondary Transformer, Dry, 15 kVA       | 62    | 62  | 62  | 62  | 62  | 62    | 62  | 62    | 62  | 62    | 62   | 62  | 62  | 62    | 62  | 62   | 62  | 62    | 62    | 62  | 62   | 62  | 62  | 62  | 62    |
| Replace Power Panel Board, 480 V, 1,000 Amp.      |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Repair Power Panel Board, 480 V, 1,000 Amp.       |       |     |     |     |     |       |     | 2,894 |     |       |      |     |     |       |     |      |     | 2,894 |       |     |      |     |     |     |       |
| Replace Coil, Motor Starter, 5-20 HP, <600 V      | 1,206 |     |     |     |     | 1,206 |     |       |     | 1,206 |      |     |     | 1,206 |     |      |     |       | 1,206 |     |      |     |     |     | 1,206 |
| Replace Power Panel Board, 480 V, 400 Amp.        |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Replace Power Panel Board, 208 Y/120 V, 400 Amp.  |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Replace Power Panel Board, 208 Y/120 V, 100 Amp.  |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Maintain Power Panel Board, 208 Y/120 V, 225 Amp. | 550   | 550 | 550 | 550 | 550 | 550   | 550 | 550   | 550 | 550   | 550  | 550 | 550 | 550   | 550 | 550  | 550 | 550   | 550   | 550 | 550  | 550 | 550 | 550 | 550   |
| Repair Power Panel Board, 208 Y/120 V, 225 Amp.   |       |     |     |     |     |       |     | 882   |     |       |      |     |     |       |     |      |     | 882   |       |     |      |     |     |     |       |
| Replace Power Panel Board, 208 Y/120 V, 225 Amp.  |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Maintain Power Panel Board, 480 V, 1,000 Amp.     | 245   | 245 | 245 | 245 | 245 | 245   | 245 | 245   | 245 | 245   | 245  | 245 | 245 | 245   | 245 | 245  | 245 | 245   | 245   | 245 | 245  | 245 | 245 | 245 | 245   |
| Repair Power Panel Board, 208 Y/120 V, 400 Amp.   |       |     |     |     |     |       |     | 1,274 |     |       |      |     |     |       |     |      |     | 1,274 |       |     |      |     |     |     |       |
| Repair Power Panel Board, 208 Y/120 V, 100 Amp.   |       |     |     |     |     |       |     | 3,137 |     |       |      |     |     |       |     |      |     | 3,137 |       |     |      |     |     |     |       |
| Maintain Power Panel Board, 480 V, 100 Amp.       | 550   | 550 | 550 | 550 | 550 | 550   | 550 | 550   | 550 | 550   | 550  | 550 | 550 | 550   | 550 | 550  | 550 | 550   | 550   | 550 | 550  | 550 | 550 | 550 | 550   |
| Repair Power Panel Board, 480 V, 100 Amp.         |       |     |     |     |     |       |     | 882   |     |       |      |     |     |       |     |      |     | 882   |       |     |      |     |     |     |       |
| Replace Power Panel Board, 480 V, 100 Amp.        |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Maintain Power Panel Board, 480 V, 200 Amp.       | 673   | 673 | 673 | 673 | 673 | 673   | 673 | 673   | 673 | 673   | 673  | 673 | 673 | 673   | 673 | 673  | 673 | 673   | 673   | 673 | 673  | 673 | 673 | 673 | 673   |
| Repair Power Panel Board, 480 V, 200 Amp.         |       |     |     |     |     |       |     | 1,078 |     |       |      |     |     |       |     |      |     | 1,078 |       |     |      |     |     |     |       |
| Replace Power Panel Board, 480 V, 200 Amp.        |       |     |     |     |     |       |     |       |     |       |      |     |     |       |     |      |     |       |       |     |      |     |     |     |       |
| Maintain Power Panel Board, 480 V, 400 Amp.       | 428   | 428 | 428 | 428 | 428 | 428   | 428 | 428   | 428 | 428   | 428  | 428 | 428 | 428   | 428 | 428  | 428 | 428   | 428   | 428 | 428  | 428 | 428 | 428 | 428   |
| Maintain Power Panel Board, 208 Y/120 V, 400 Amp. | 795   | 795 | 795 | 795 | 795 | 795   | 795 | 795   | 795 | 795   | 795  | 795 | 795 | 795   | 795 | 795  | 795 | 795   | 795   | 795 | 795  | 795 | 795 | 795 | 795   |

## E10 Equipment

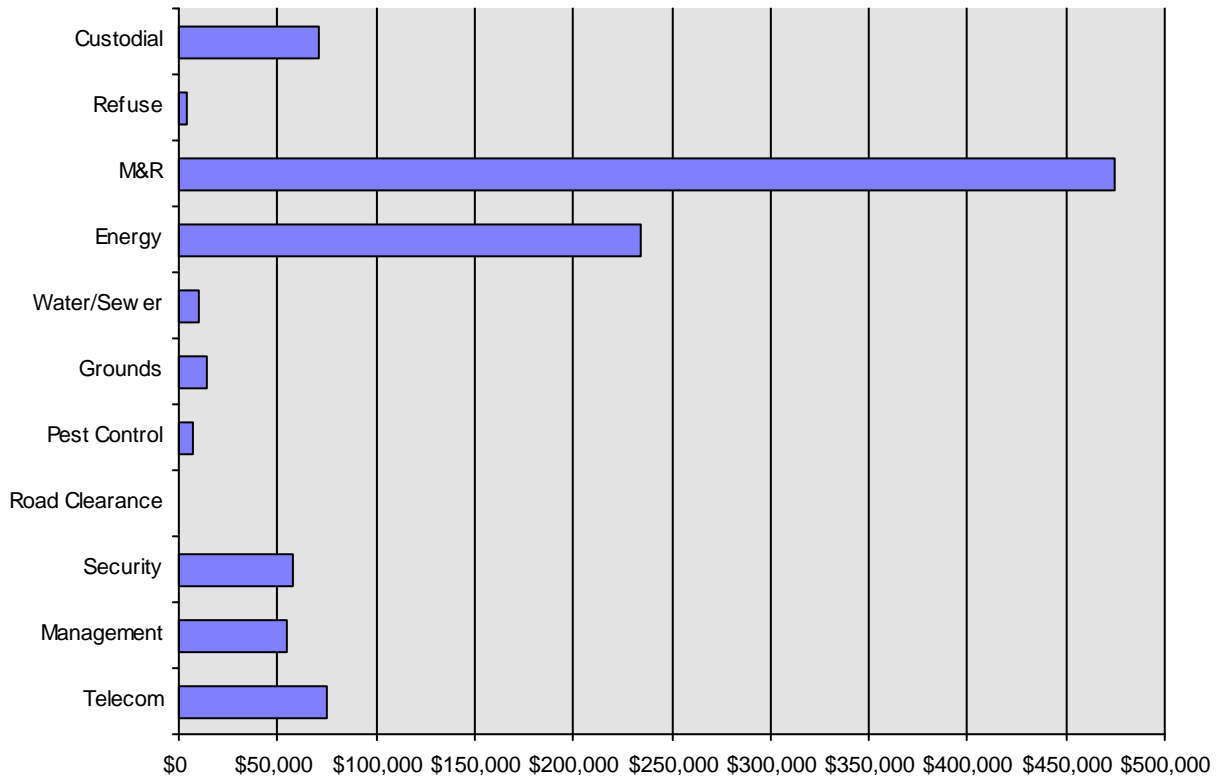
|                                      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Replace Laboratory Exhaust Hood, 6'  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Maintain Laboratory Exhaust Hood, 6' | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 | 380 |

# Operation Costs Summary

Whitestone Research

**Building:** Propulsion Research & Development      **GSFT:** 110,279  
**Building Number:** 1045/62/346      **Replacement Value:** \$21,781,307  
**Facility:** Marshall Space Flight Center      **Building Use:** Laboratory  
**City:** Huntsville, AL      **Building Type:** Propulsion Building  
**Built Date:** 2005

| Operation             | Annual Cost/GSFT | Annual Total       | Percent       |
|-----------------------|------------------|--------------------|---------------|
| Custodial             | \$0.648          | \$71,490           | 7.1%          |
| Energy                | \$2.123          | \$234,171          | 23.3%         |
| Grounds               | \$0.125          | \$13,828           | 1.4%          |
| M&R                   | \$4.307          | \$474,972          | 47.3%         |
| Management            | \$0.494          | \$54,453           | 5.4%          |
| Pest Control          | \$0.067          | \$7,380            | 0.7%          |
| Refuse                | \$0.033          | \$3,660            | 0.4%          |
| Road Clearance        | \$0.002          | \$252              | 0.0%          |
| Security              | \$0.528          | \$58,240           | 5.8%          |
| Telecom               | \$0.678          | \$74,733           | 7.4%          |
| Water/Sewer           | \$0.091          | \$10,015           | 1.0%          |
| <b>Building Total</b> | <b>\$9.10</b>    | <b>\$1,003,194</b> | <b>100.0%</b> |



# Building Operations Task Details

Whitestone Research

**Building:** Propulsion Research & Development L

**Year Built:** 2005

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/346

**City:** Huntsville, AL

**Replacement Value:** \$21,781,307 **per SF:** \$198

**Building Gsft:** 110,279

| Functional Area             | FA GSFT | Task   | Labor Cost | Material Cost | Task Cost |
|-----------------------------|---------|--|------------|---------------|-----------|
| <b>Operation: Custodial</b> |         | <b>Level of Service: Low</b>   |            |               |           |
| Laboratory                  | 69475   | Wet Mop & Rinse Hard Floor with 32 oz. Mop Using Single Bucket & Wringer                       | \$20,810   | \$3,382       | \$24,192  |
| Laboratory                  | 69475   | Empty Trash; Wipe Clean & Re-line Basket   | \$6,937    | \$1,127       | \$8,064   |
| Laboratory                  | 69475   | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$4,258    | \$692         | \$4,950   |
| Laboratory                  | 69475   | Dust Surfaces with Duster  | \$3,202    | \$520         | \$3,722   |
| Laboratory                  | 69475   | Dust Window Blinds   | \$1,537    | \$250         | \$1,786   |
| Office                      | 22055   | Vacuum Carpet with 14" Upright Vacuum  | \$7,707    | \$1,252       | \$8,960   |
| Office                      | 22055   | Empty Trash; Wipe Clean & Re-line Basket   | \$2,202    | \$358         | \$2,560   |
| Office                      | 22055   | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$1,352    | \$220         | \$1,571   |
| Office                      | 22055   | Dust Surfaces with Duster  | \$1,016    | \$165         | \$1,182   |
| Office                      | 22055   | Vacuum Upholstered Furniture with Tank or Canister Vacuum                                      | \$846      | \$137         | \$984     |
| Office                      | 22055   | Dust Window Blinds   | \$488      | \$79          | \$567     |
| Common/Circulation Are      | 5513    | Vacuum Carpet with 14" Upright Vacuum  | \$3,853    | \$626         | \$4,479   |
| Conference Room             | 5513    | Vacuum Carpet with 14" Upright Vacuum  | \$1,927    | \$313         | \$2,240   |
| Conference Room             | 5513    | Clean and Wipe Furniture with Trigger Sprayer & Cloth  | \$732      | \$119         | \$851     |
| Common/Circulation Are      | 5513    | Empty Trash; Wipe Clean & Re-line Basket   | \$550      | \$89          | \$640     |
| Common/Circulation Are      | 5513    | Vacuum Upholstered Furniture with Tank or Canister Vacuum                                      | \$423      | \$69          | \$492     |
| Conference Room             | 5513    | Empty Trash; Wipe Clean & Re-line Basket   | \$275      | \$45          | \$320     |
| Mechanical/Equipment        | 5513    | Sweep Hard Floor with 48" Push Broom   | \$99       | \$16          | \$115     |
| Mechanical/Equipment        | 5513    | Empty Trash; Wipe Clean & Re-line Basket   | \$64       | \$10          | \$74      |
| Restroom                    | 1102    | Service Restroom: Empty Trash, Clean & Disinfect Fixtures, Wipe Mirrors, Replace Supplies, Wet | \$2,311    | \$375         | \$2,686   |
| Restroom                    | 1102    | Service Restroom: Empty Trash, Replace Supplies & Touch Up as Needed                           | \$354      | \$58          | \$412     |
| Break Room                  | 1102    | Empty, Clean and Disinfect Refrigerator  | \$212      | \$34          | \$246     |
| Break Room                  | 1102    | Damp Wipe Interior and Exterior Cupboard   | \$135      | \$22          | \$157     |
| Break Room                  | 1102    | Scrub and Damp Wipe Sinks  | \$68       | \$11          | \$79      |
| Break Room                  | 1102    | Wet Mop & Rinse Hard Floor with 32 oz. Mop Using Double Bucket & Wringer                       | \$63       | \$10          | \$74      |
| Break Room                  | 1102    | Clean and Polish Metal Surfaces with Trigger Sprayer & Cloth                                   | \$51       | \$8           | \$59      |
| Break Room                  | 1102    | Empty Trash; Wipe Clean & Re-line Basket   | \$25       | \$4           | \$30      |

| Functional Area                  | FA GSFT | Task   | Labor Cost      | Material Cost  | Task Cost       |
|----------------------------------|---------|--|-----------------|----------------|-----------------|
| <b>Total:</b>                    |         |  | <b>\$61,497</b> | <b>\$9,993</b> | <b>\$71,490</b> |
| <b>Operation: Grounds</b>        |         | <b>Level of Service: Low</b>                   |                 |                |                 |
| Grounds, Improved                | 66167   | Mow Turfgrass with 21" Power Mower             | \$2,443         | \$1,016        | \$3,460         |
| Grounds, Improved                | 66167   | Aerate Improved Grounds                        | \$1,896         | \$789          | \$2,684         |
| Grounds, Improved                | 66167   | Clear Shrubs                                   | \$1,583         | \$659          | \$2,242         |
| Grounds, Improved                | 66167   | Edge Clean & Trim Walks with Gas Powered Edger | \$1,014         | \$422          | \$1,436         |
| Grounds, Improved                | 66167   | Overseed, Improved Grounds                     | \$948           | \$394          | \$1,342         |
| Grounds, Improved                | 66167   | Vacuum with 30" Billy Goat                     | \$633           | \$263          | \$897           |
| Grounds, Improved                | 66167   | Clear Crabgrass                                | \$474           | \$197          | \$671           |
| Grounds, Improved                | 66167   | Clear Weeds with 15" Boom, Improved Grounds    | \$252           | \$105          | \$357           |
| Grounds, Improved                | 66167   | Trim Around Raised Objects with String Edger   | \$208           | \$86           | \$294           |
| Grounds, Improved                | 66167   | Fertilize Improved Grounds                     | \$190           | \$79           | \$268           |
| Grounds, Improved                | 66167   | Sweep with 30" Power Rake                      | \$125           | \$52           | \$177           |
| Grounds, Improved                | 66167   | Fertilize Using Power Take Off Broadcast       | \$0             | \$0            | \$0             |
| <b>Total:</b>                    |         |  | <b>\$9,766</b>  | <b>\$4,063</b> | <b>\$13,828</b> |
| <b>Operation: Pest Control</b>   |         | <b>Level of Service: Medium</b>                |                 |                |                 |
| Pest Controlled                  | 110279  | Install, or Check and Re-Bait 5 Rodent Boxes   | \$2,548         | \$1,060        | \$3,608         |
| Pest Controlled                  | 110279  | Perform Crawling Insect Abatement              | \$1,913         | \$796          | \$2,709         |
| Pest Controlled                  | 110279  | Inspect Building for Pests                     | \$1,064         | \$0            | \$1,064         |
| <b>Total:</b>                    |         |  | <b>\$5,524</b>  | <b>\$1,856</b> | <b>\$7,380</b>  |
| <b>Operation: Road Clearance</b> |         | <b>Level of Service: Medium</b>                |                 |                |                 |
| Pavement NASA                    | 88223   | Plow Paved Area                                | \$194           | \$58           | \$252           |
| <b>Total:</b>                    |         |  | <b>\$194</b>    | <b>\$58</b>    | <b>\$252</b>    |
| <b>Operation: Security</b>       |         | <b>Level of Service: Medium</b>                |                 |                |                 |
| Secured Area                     | 110279  | Patrol Building Perimeter                      | \$20,961        | \$3,406        | \$24,367        |
| Secured Area                     | 110279  | Guard Lobby/Parking                            | \$0             | \$0            | \$0             |
| <b>Total:</b>                    |         |  | <b>\$20,961</b> | <b>\$3,406</b> | <b>\$24,367</b> |

# Building Operations Utility Details

Whitestone Research

**Building:** Propulsion Research & Development L

**Year Built:** 2005

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/346

**City:** Huntsville, AL

**Replacement Value:** \$21,781,307 **per SF:** \$198

**Building Gsft:** 110,279

|                   | Utility               | GSFT                            | Demand        | UM  | Rate     | Cost             |
|-------------------|-----------------------|---------------------------------|---------------|-----|----------|------------------|
| <b>Operation:</b> | <b>Energy</b>         | <b>Level of Service: Low</b>    |               |     |          |                  |
|                   | Electricity           | 110279                          | 20.244        | kWh | \$0.0833 | \$185,962        |
|                   | Natural Gas           | 110279                          | 0.553         | Thm | \$0.7900 | \$48,209         |
|                   | Diesel                | 110279                          | 0.000         | Gal | \$3.2100 | \$0              |
|                   | <b>Total:</b>         |                                 | <b>20.797</b> |     |          | <b>\$234,171</b> |
| <b>Operation:</b> | <b>Refuse</b>         | <b>Level of Service: Medium</b> |               |     |          |                  |
|                   | Municipal Solid Waste | 110279                          | 0.370         | Lbs | \$0.0717 | \$2,926          |
|                   | Recycling             | 110279                          | 0.180         | Lbs | \$0.0370 | \$734            |
|                   | <b>Total:</b>         |                                 | <b>0.550</b>  |     |          | <b>\$3,660</b>   |
| <b>Operation:</b> | <b>Water/Sewer</b>    | <b>Level of Service: Medium</b> |               |     |          |                  |
|                   | Sewer                 | 110279                          | 18.920        | Gal | \$0.0034 | \$7,094          |
|                   | Water                 | 110279                          | 24.080        | Gal | \$0.0011 | \$2,921          |
|                   | <b>Total:</b>         |                                 | <b>43.000</b> |     |          | <b>\$10,015</b>  |

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# Building Operations Management Details

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Whitestone Research

**Building:** Propulsion Research & Development L

**Year Built:** 2005

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/346

**City:** Huntsville, AL

**Replacement Value:** \$21,781,307 **per SF:** \$198

**Building Gsft:** 110,279

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|                              | Service                      | Demand | UM  | PRV          | Cost            |
|------------------------------|------------------------------|--------|-----|--------------|-----------------|
| <b>Operation:</b> Management | <b>Level of Service:</b> Low |        |     |              |                 |
|                              | Management                   | 0.3%   | PRV | \$21,781,307 | \$54,453        |
|                              | <b>Total:</b>                |        |     |              | <b>\$54,453</b> |

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# Building Operations Service Details

Whitestone Research

**Building:** Propulsion Research & Development L

**Year Built:** 2005

**FTEs:** 83

**Building Type:** Propulsion Building

**Facility:** Marshall Space Flight Center

**Original Cost:** \$1

**Building Num:** 1045/62/346

**City:** Huntsville, AL

**Replacement Value:** \$21,781,307

**per SF:** \$198

**Building Gsft:** 110,279

|                   |                 | Service*                        | Quantity | Rate    | Cost            |
|-------------------|-----------------|---------------------------------|----------|---------|-----------------|
| <b>Operation:</b> | <b>Security</b> | <b>Level of Service: Medium</b> |          |         |                 |
|                   |                 | Intrusion Detection Systems     | 3        | \$4,986 | \$14,958        |
|                   |                 | System Monitoring               | 3        | \$3,615 | \$10,845        |
|                   |                 | Access Control                  | 3        | \$2,690 | \$8,070         |
|                   |                 | <b>Total:</b>                   |          |         | <b>\$33,873</b> |
| <b>Operation:</b> | <b>Telecom</b>  | <b>Level of Service: High</b>   |          |         |                 |
|                   |                 | Local Telephone                 | 83       | \$468   | \$38,844        |
|                   |                 | Data                            | 83       | \$3,588 | \$19,953        |
|                   |                 | Long Distance Telephone         | 83       | \$192   | \$15,936        |
|                   |                 | <b>Total:</b>                   |          |         | <b>\$74,733</b> |