SUBJECT INDUSTRIAL CONTROL SYSTEMS REQUIREMENTS PROCEDURE

PURPOSE

The purpose of this document is to define the Industrial Control System (ICS) requirements for creating assets, listing in the Control Systems Inventory Data Requirements Description (DRD) document and software back up procedures for all Base Operations and Spaceport Services contract (BOSS) maintained ICS source code and/or settings. so that any ICS can be restored to service without having to recreate the source code and/or settings from scratch. Additionally, this procedure defines the ICS Backup Repository (ICSBR) location and administrative controls of the for the process to archive and retrieve the backup files.

SCOPE AND APPLICABILITY

This document applies to all personnel and processes involved in the creation, modification, or maintenance of BOSS maintained ICS source code files and/or settings.

BOSS maintained ICS includes all microprocessor-based control systems with user-configurable source code and/or settings that control BOSS maintained systems. Those systems include but are not limited to:

- Bridges
- Elevators
- Fire Alarms/Suppression
- Heating, Ventilating and Air Conditioning (HVAC)
- Ignition Overpressure and Sound Suppression (IOPSS)
- Kennedy Complex Control System (KCCS)
- Low Voltage
- Medium/High Voltage
- Electronic Security Systems (ESS)
- Tornado Area Warning System (TAWS)
- Traffic Signals
- Water/Waste Water

PROCESS

1. ICS ASSET AND DEFINITION REQUIREMENTS

1.1. General ICS Asset Requirements/Definitions

All controllers that fit the requirements for the Control System Inventory Report DRD-040 shall be identified as controls assets in Maximo separately from those assets that they control except as follows:

If the equipment has an integral (including the addition of a communication module designed specifically for that equipment) control/communication capability and is in Maximo identified as another asset category.

For example, if a media converter or some other external device is required for that equipment to communicate on the network, then that external device shall be an asset in Maximo and not included in the Control System Inventory DRD.

1.2. KCCS Field Interface Controllers

All equipment identified as a Field Interface Controller (FIC) on the Kennedy Complex Control System (KCCS) network shall be identified as assets in Maximo and in the Control System Inventory DRD except as noted above.

The FIC number shall be in the asset description in the format [FICXXXX] where XXXX is the FIC number. This may be at either the beginning or end of the description.

1.3. Control Systems Servers and Workstations

All Control Systems servers and workstations shall be identified as controls assets in Maximo and in the Control System Inventory DRD.

1.4. Modular Control Systems (e.g. Programmable Logic Controllers)

1.4.1. Programmable Logic Controllers (PLC) or other similar modular controls shall be identified as an asset in Maximo as a complete system, not as individual modules.

1.4.2. The parts that make up the modular control system configuration, including such items as backplanes and Input / Output (I/O) and communication modules, shall be identified as Spare Parts on the modular control system asset in Maximo.

1.4.3. External relay or terminal blocks or similar equipment may, but are not required to, be identified as Spare Parts on the modular control system asset in Maximo.

2. CONTROL SYSTEMS INVENTORY DRD REQUIREMENTS

The Control Sytems Inventory List is a NASA Data Requirements Descriptions (DRD) (Also known as DRD-040) requirement that is presented to NASA yearly as part of the BOSS Performance Work Statement (PWS) section 3.2.1.5.1.

2.1. Location of Information

The Control System Inventory Report shall be maintained in a Microsoft Excel spreadsheet on the CSWT SharePoint site.

The Control System Inventory Report shall also be published annually in the NASA Technical Documentation Library (TechDoc).

2.2. Inclusion Criteria

All microprocessor-based controllers that are part of the following systems shall be included on the Control System Inventory Report (DRD) and as assets in Maximo.

- System-Specific Control Systems
  Examples: Substation PLC, ODMS PLC, DDC…
- PLC/CPU based systems with application specific software/firmware that must be saved for backup utilization
- Kennedy Complex Control System (KCCS) meeting above requirement
- Payload Processing Facilities (PPF) Building Automation System (BAS)
- Industrial Operating Zone (IOZ) BAS

All items that are no longer part of the BOSS contract or that have been demolished shall be removed from the list.

2.3. Required Information

2.3.1. **ID -** Unique list item number

2.3.2. **Facility Number**

- All facility numbers shall include any leading zeroes. (e.g. use K6-0848, not K6-848).
- Facility names shall not be used.

2.3.3. **Device Name**

- Devices that have a specific Maximo asset record shall use the Maximo asset description.
- Devices shall be named based on the function of the controller. This is typically the name of the equipment that is being controlled.
- Devices on KCCS shall include the FIC number as part of the device name as described in section 1.2.

2.3.4. **System Controlled**

- The high-level system code for the system that is being controlled shall be limited to those in Appendix A.
- Additional system codes may be requested.

2.3.5. **Network**

- The network(s) that the controller is a part of shall be identified (e.g. KCCS Utility, KCCS Power, VLAN18, etc.)
- If the controller is not part of a network, then “None” shall be entered.

2.3.6. **Type of Controller**

The high-level type of controller, e.g. PLC, Server, Fire Alarm, etc., shall be identified.

2.3.7. **Controller Brand Name**

- The manufacturer of the controller shall be used as the Controller Brand Name.
- When a manufacturer is acquired by another company, the Controller Brand Name shall be updated at the next opportunity.
    - The legacy brand name may be moved to be a part of the Controller Model Number if it is still used after the acquisition.
    - For example, “Andover” and “Modicon” would both become “Schneider Electric” as the brand and “Andover” or “Modicon” would become part of the model.

2.3.8. **Controller Model**

The model family shall be used as the Controller Model. (e.g. ControlLogix, Continuum).

2.3.9. **Central Processing Unit (CPU) Model Number**

The manufacturer part number for the controller (or CPU module if a modular controller) shall be used for the CPU Model Number. (e.g. 1756-L64, i2920).

2.3.10. **Backup Document Number**

The Document number of the source code/settings in the Industrial Control Systems Backup Repository (ICSBR).

2.3.11. **Backup Date**

The date of the last software backup to the Controls Backup Tool shall be entered immediately after the backup is uploaded.

2.3.12. **Programming Software and Version**

- The name and version of the software application used to write the controller code shall be recorded.
- Any special platform requirements (e.g. only runs on Windows XP, etc.) shall be recorded in the comments field.

2.3.13. **Programming Tool**

- Any special hardware required to connect to and program the controller (e.g. cables, converters, etc.) shall be recorded.
- If the controller can be programmed/configured from a workstation on the network, then “Network” shall be entered.
- If no special tool is required (as in the case of a workstation or server), then “None” shall be entered.

2.3.14. **Maximo Asset Number**

- The Maximo asset number for the controller shall be identified.
- If the controller does not have a specific asset number assigned in Maximo, then one of the following asset numbers shall be used:
  - The asset number for the equipment it controls.
  - The general facility asset number (e.g. M6-0399HVCUC).
- The use of these alternate Maximo asset numbers shall be temporary until such time as a specific asset record is created in Maximo for the controller.

2.3.15. **Work Unit Code (WUC)**

The WUC associated with the Maximo Asset chosen shall be entered.

2.3.16. **Spares Available**

Enter ‘Y’ if spares are available on center; otherwise enter ‘N’.

2.3.17. **App Admin**

- The Application Administrator for the controller shall be identified.
- The format for the name shall be: Last Name, First Name

2.3.18. **Comments**

Any comments related to the controller that do not belong in any other field may be entered.

2.4. Optional data – Not required of submission

ICS TecDoc Document number for tracking purposes

DRD Remarks information – Explaining any information as to the asset

3. ICSBR

The Document number of the source code/settings is filed in the Industrial Control Systems Backup Repository (ICSBR). The ICSBR is located in the TDOPS Technical Documentation Library (TechDoc). This location was chosen since it provides the following features:

- **Access Controlled** – Only certain users, typically the Application Administrators, may have access to the ICS backup files based on the standard NDC login credentials.

- Approved users may be granted access by contacting the Controls Lead System Engineer (SE).

- **Versioning** – When the ICS backup file is updated and released, the previous version is retained in history and remains available.
- **Searchable** – Documents may be assigned metadata called keywords that allow users to search for documents based on facility where the controller is located and by the system(s) that it supports as well as the Maximo asset number.
- **Standard** – TechDoc is used to store and make available other technical data, including configured drawings, making the user interface familiar for users of the ICSBR.

4. ICS STORAGE REQUIREMENTS

4.1. Storage Time Line

ICS backups for non-configured systems shall be archived in the ICSBR within 30 days of implementing changes and completing required testing per ENG-P-0025, *FSEU Software Change Control and Administration*. For configured systems, ICS backups shall follow the OMD schedule for their release.

4.2. Required Files

These are the minimum required files to be included in the ICSBR. All files – source code, Portable Document Format (PDF) version, and all other files identified below – shall be combined into a ZIP package for upload to the ICSBR.

4.2.1. Controllers with source code that can be backed up (e.g. Programmable Logic Controllers) shall contain the following files in the ZIP package:

4.2.1.1. Executable source code (e.g. ladder logic, function block diagram, etc.).

- Can be a single file or multiple, depending on the controller and programming software.
- Any additional files, such as for user-defined functions, that are required for the main source code to function properly.

4.2.1.2. Human-readable PDF version of source code.

- If the programming software outputs an American Standard Code for Information Interchange (ASCII) file, then convert that to a PDF prior to adding to the repository.
- Include a cover page using ENG-F-1035, Industrial Control Systems Source Code/Settings Backup - Cover Page.

4.2.1.3. If there are specific steps that need to be performed to connect to and program the controller, then a procedure for doing so shall be included.

4.2.2. Controllers with source code that cannot be backed up (e.g. Gateways, Intelligent Electronic Devices (IEDs)) shall contain the following files in the ZIP package:

4.2.2.1. Word or Excel document that details each of the settings and their values.

4.2.2.1.1. If programmed via a web page interface, a screen shot of each configured setting is an acceptable and preferred method of documenting the settings values.

4.2.2.2. PDF version of the Word/Excel document

- Include a cover page using ENG-F-1035

4.2.2.3. If there are specific steps that need to be performed to connect to and/or program the controller, then a procedure for doing so shall be included.

4.2.3. Source code that is common to multiple ICS shall contain all documents required above, based on whether code can be backed up, in the ZIP package.

4.2.4. Controllers that use common code shall contain the following files in the ZIP package:

4.2.4.1. Word document using ENG-F-1035 that contains the following additional information:

- ICS backup document number that contains the common code/settings
- ICS backup document version number of the code/settings that is/are installed on the controller

4.2.4.2. If there are specific steps that need to be performed to connect to and/or program the controller, then a procedure for doing so shall be included.

4.2.5. User manuals and data sheets are not required to be backed up as they are typically available online from the manufacturer.

4.3. Naming Convention

4.3.1. The document number in the ICSBR shall use the number convention ICS-[ASSETNUMBER] where [ASSETNUMBER] is the Maximo asset number assigned to the controller.

- Example: ICS-FIC0018

4.3.2. The document number for source code that is common to multiple controllers shall use the number convention ICS-[ASSETCATEGORY]-[##]. Include the number in case there are multiple versions of code for a certain asset category.

- Example: ICS-PowerMeter-01

4.3.3. The document title in the ICSBR shall contain a simple description of the asset that uses the code followed by “Source Code” or “Settings” as appropriate.

4.3.3.1. If the controller is identified as a Field Interface Controller (FIC) on the Kennedy Complex Control System (KCCS) network, then the document title in the ICSBR shall contain the FIC number.

4.3.4. The source code/settings ZIP package file name shall match the ICSBR document number convention with the revision date and document title appended as follows:

- ICS-[ASSETNUMBER]-[DATE]-[DOCUMENTTITLE]

4.3.4.1. The date shall be in YYYYMMDD format and is the date the code was loaded/verified on the controller.

- Example: ICS-FIC0018-20120523-FIC0018-Source-Code

4.3.5. The individual documents in the ZIP package shall be named as follows:

4.3.5.1. The executable source code file shall be named with the ICSBR document number and revision where the programming software allows.

4.3.5.2. The PDF version of the source code or settings document file shall be named the same as the ZIP package: ICSBR document number, revision date, and title.

4.3.5.3. If the source code is configured and released through the Engineering Documentation Center (EDC), then the configured drawing number used may be used in the ZIP package as well.

5. ARCHIVAL AND RETRIEVAL INSTRUCTIONS

5.1. Archive a Backup

Due to the limited access requirements of TechDoc, the Controls Lead System Engineer/Design Engineer (SE/DE) or a designated alternate (ICS Document Manager) shall be responsible for performing all actions within TechDocs related to archiving ICS backup records.

5.1.1. New ICS Backup

5.1.1.1. The Application Administrator shall prepare the backup package in accordance with Section 4 and provide to Controls Lead SE/DE via encrypted email or external storage device (e.g. CD-ROM, USB Drive).

5.1.1.2. Each software release package shall be reviewed by a CUI Designating Official and Export Control Representative. The CUI determination will be reflected on the ENG-F-1035 cover.

If the package is determined to be CUI, then the Doc Category shall be “CUI”. A CUI cover sheet, GSA Standard Form 901, will be attached in front of the ENG-F-1035 cover.

If the package is determined to not be CUI, then the Doc Category shall be “NS-REV” (Non-Sensitive/Reviewed) and a CUI cover sheet will not be attached to the ENG-F-1035 cover.

5.1.1.3. The Controls Lead SE shall create a new document record in the ICSBR with the following information:

Document Property	Value
Document Number	In accordance with Section 4.3.1
Document Title	In accordance with Section 4.3.3
Doc Type	Tech_Document
Doc Category	In accordance with Section 5.1.1.2
Point of Contact	Application Administrator
Organization	BOSS-FSE
Web Search	Community
Resident Document	Yes

Reason	PCN/WON that approved/directed the creation of the source code
Keyword: Contract	BOSS
Keyword: Location	Facility number were the controller is located
Keyword: System	System code of the system(s) supported by the controller (See Appendix A)
File	ZIP package provided by the SE
Fetch Access	Restricted

5.1.1.4. The Controls Lead SE/DE shall associate access for the document in the ICSBR as follows:

- Provide read-only access to the ICS-Engineers group.
- Verify/remove any other access.

5.1.1.5. The Controls Lead SE/DE shall verify/provide distribution for the document in the ICSBR to the ICS-Distribution group.

5.1.1.6. The Controls Lead SE/DE shall release the document in the ICSBR with the following information;

Document Property	**Value**
Generation	1.0
Revision	Date the ICS source code and/or settings were installed on the controller
Reason	PCN/WON that approved/directed the creation of the source code

5.1.2. Update ICS Backup (i.e. New Revision)

5.1.2.1. The Application Administrator shall prepare the backup package in accordance with Section 4 and provide to ICS Document Manager via encrypted email or external storage device (e.g. CD-ROM, USB Drive).

5.1.2.2. The ICS Document Manager shall reserve the document in the ICSBR. Enter “New Revision” as the Reason.

5.1.2.3. The ICS Document Manager shall replace the document in the ICSBR. Enter “New Revision” as the Reason.

5.1.2.4. The Controls Lead SE/DE shall verify/provide access for the document in the ICSBR in accordance with Section 3.

5.1.2.5. The Controls Lead SE/DE shall verify/provide distribution for the document in the ICSBR to the ICS-Distribution group.

5.1.2.6. The Controls Lead SE/DE shall release the document in the ICSBR with the following information;

Document Property	Value
Generation	Next available.
Revision	Date the ICS source code and/or settings were installed on the controller
Reason	PCN/WON that approved/directed the creation of the source code

5.2. Archive Requirements

The latest and previous five versions of ICS source code and/or settings shall be maintained in the ICSBR.

5.3. Find a Backup

As these backup files reside in TechDoc, they may be found using the standard TechDoc search functionality. The following search methods are provided to assist locating the ICS backups from TechDoc but are not the only methods to do so. Tips on using TechDoc search functionality can be found at https://tdsearch.ksc.nasa.gov/search/brief-help.html.

5.3.1. Find a Specific ICS Backup

5.3.1.1. Go to the TechDoc search page at https://tdsearch.ksc.nasa.gov/

5.3.1.2. Enter the exact ICS backup document number in the search box and click the “Doc Number” radio button.

5.3.1.3. Press Enter on the keyboard or click “Speed Search”.

Figure 1 - TechDoc Search Criteria to Find a Specific ICS Backup

5.3.2. Find All ICS Backups

5.3.2.1. Go to the TechDoc search page at https://tdsearch.ksc.nasa.gov/

5.3.2.2. Enter ICS* in the search box and click the “Doc Number” radio button.

5.3.2.3. Press Enter on the keyboard or click “Speed Search”.

Figure 2 - TechDoc Search Criteria to Find All ICS Backups

5.3.3. **Find One or More Facility and/or System Specific ICS Backups**

5.3.3.1. Go to the TechDoc advanced search page at https://tdsearch.ksc.nasa.gov/search/general.html

5.3.3.2. Select “Document Number” in the first “Search field” box and enter ICS* in the first “Search text” box.

5.3.3.3. Select “Keywords” in the second “Search field” box and enter the facility or system (See Appendix A) in the second “Search text” box. Ensure that the “And” radio button is selected above the second search criteria section.

5.3.3.4. To further refine the search results, a second keyword (or other criteria such as Point of Contact) can be used in the third search criteria section.

5.3.3.5. Press Enter on the keyboard or click “Search”.

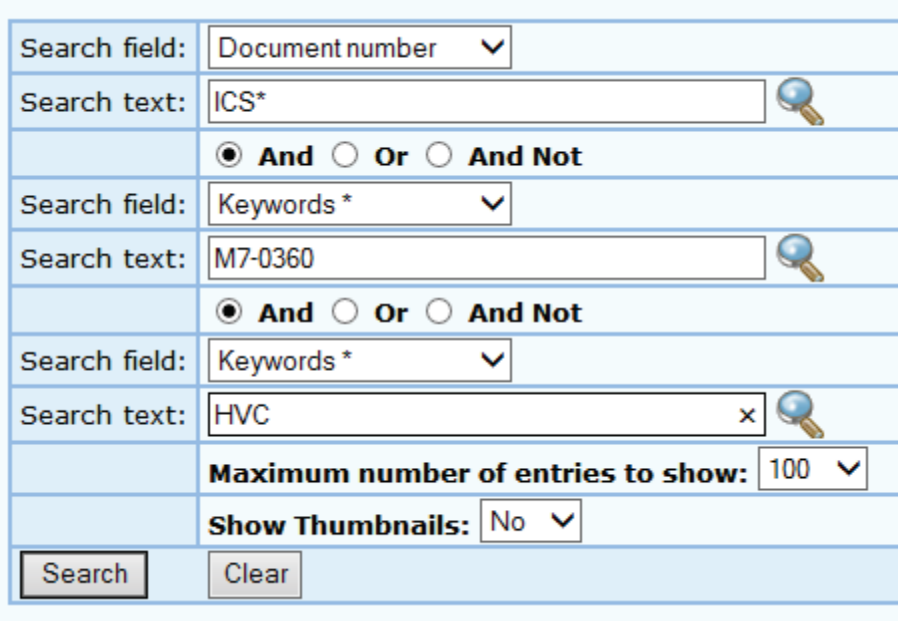


Figure 3 - TechDoc Search Criteria Example Using Keywords

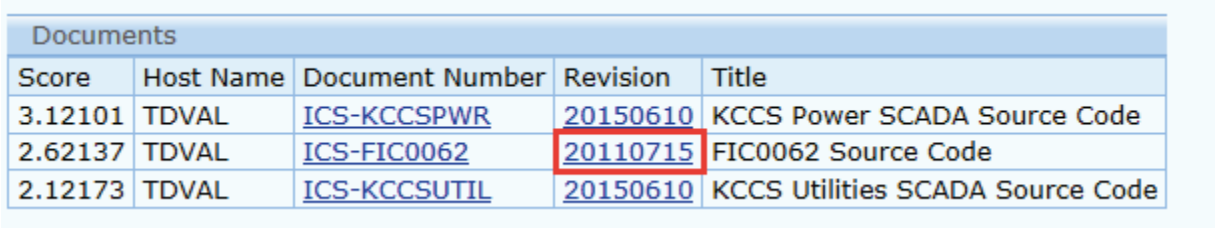
5.4. Retrieve a Backup

5.4.1. Retrieve the Current ICS Backup Revision

5.4.1.1. Find the ICS backup document using one of the above search methods.

5.4.1.2. Click on the revision number for the document in the search results page.

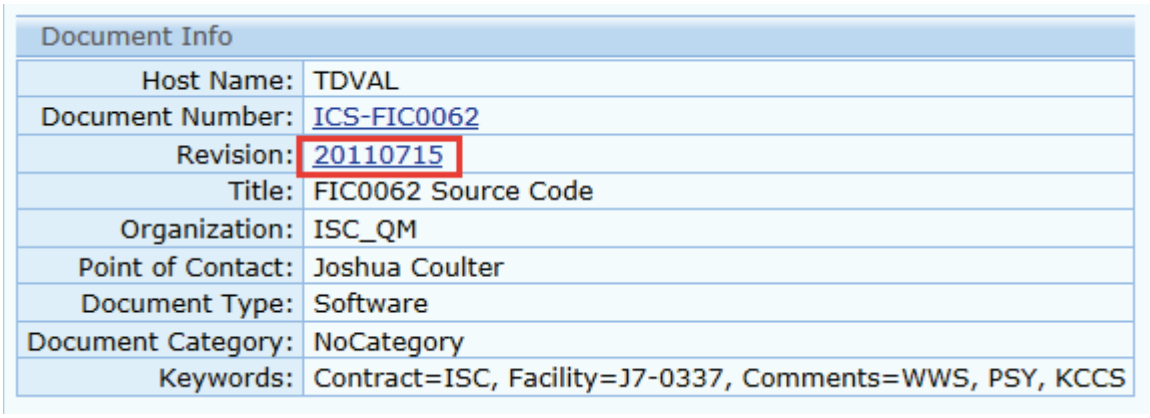
- If TechDoc requests Login credentials after clicking the revision, contact the Controls Lead SE/DE to request access to retrieve the ICS backup document.



Documents

Score	Host Name	Document Number	Revision	Title
3.12101	TDVAL	ICS-KCCSPWR	20150610	KCCS Power SCADA Source Code
2.62137	TDVAL	ICS-FIC0062	20110715	FIC0062 Source Code
2.12173	TDVAL	ICS-KCCSUTIL	20150610	KCCS Utilities SCADA Source Code

Figure 4 - TechDoc Search Results, Multiple Documents



Document Info	
Host Name:	TDVAL
Document Number:	ICS-FIC0062
Revision:	20110715
Title:	FIC0062 Source Code
Organization:	ISC_QM
Point of Contact:	Joshua Coulter
Document Type:	Software
Document Category:	NoCategory
Keywords:	Contract=ISC, Facility=J7-0337, Comments=WWS, PSY, KCCS

Figure 5 - TechDoc Search Results, Single Document

5.4.2. View/Retrieve Previous ICS Backup Revisions

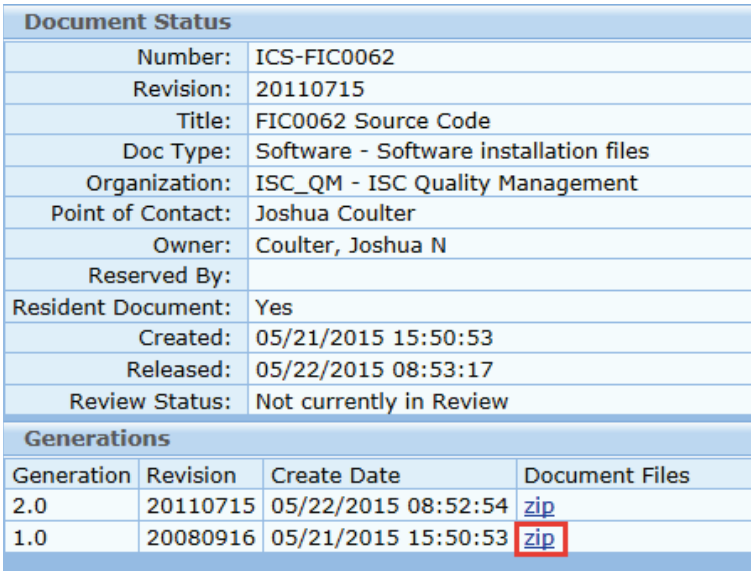
5.4.2.1. Find the ICS backup document using one of the above search methods.

5.4.2.2. Click on the document number for the document in the search results page.

- If the search returned more than one document as shown in Figure 4 - TechDoc Search Results, Multiple Documents, click the document number again on the single document search results page.

5.4.2.3. All revisions of the ICS backup document are shown at the bottom of the Document Status page. Click on the link for the desired revision in the “Document Files” column.

5.4.2.4. If TechDoc requests Login credentials after clicking the revision, contact the Controls Lead SE/DE to request access to retrieve the ICS backup document.



Document Status	
Number:	ICS-FIC0062
Revision:	20110715
Title:	FIC0062 Source Code
Doc Type:	Software - Software installation files
Organization:	ISC_QM - ISC Quality Management
Point of Contact:	Joshua Coulter
Owner:	Coulter, Joshua N
Reserved By:	
Resident Document:	Yes
Created:	05/21/2015 15:50:53
Released:	05/22/2015 08:53:17
Review Status:	Not currently in Review

Generations			
Generation	Revision	Create Date	Document Files
2.0	20110715	05/22/2015 08:52:54	zip
1.0	20080916	05/21/2015 15:50:53	zip

Figure 6 – ICS Backup Document Status Showing Previous Revisions

APPENDIX A – SYSTEM CODES

The following system codes are used in the System keyword in TechDoc.

BRG – Bridges
ELEV – Elevators
FA – Fire Alarms/Suppression
HVC – Heating, Ventilating and Air Conditioning
IOPSS – Ignition Overpressure and Sound Suppression
KCCS – Kennedy Complex Control System
PWR – Low/Medium/High Voltage
SEC – Electronic Security Systems
TAWS – Tornado Area Warning System
TS – Traffic Signals
WWS – Water/Waste Water

RECORDS

The following records are retained by the organizations listed below:

Record	Responsible Organization	NRRS Item#	Retention Period
ICS Backup Package	BOSS Engineering Services	08/107.0	Destroy/delete between 0 and 30 years after program/project termination. See Note 4

AFFECTED DIVISIONS/OFFICES

Engineering Services
FSEU and OM&E
Information Technology

MANAGEMENT ROLES AND RESPONSIBILITIES

BOSS Program Director: Ensures BOSS contract compliance to the requirements stated in this procedure. Reviews and approves or disapproves waiver requests written against this standard.

Division Manager: Ensures compliance within the Division to the requirements stated in this procedure.

Technical Operations Manager: Ensures compliance at the branch level to the requirements stated in this procedure.

Application Administrator – Prepares the backup files and provides them as a ZIP package for archival in the ICSBR.

ICS Document Manager – Assists the Controls Lead SE/DE with archiving new versions of existing ICS backups.

Controls Lead SE/DE – Manages the ICSBR and related access groups in TechDoc.

REFERENCE DOCUMENTS

The following documents are referenced in this procedure:

Document Number	Title
ENG-P-0025	FSEU Software Change Control and Administration
ENG-F-1035	Industrial Control Systems Source Code/Settings Backup - Cover Page

ACRONYMS

ASCII	American Standard Code for Information Interchange
BOSS	Base Operations and Spaceport Services contract
CUI	Controlled Unclassified Information
DE	Design Engineer
DRD	Data Requirements Document
EDC	Engineering Documentation Center
ESS	Electronic Security Systems
FIC	Field Interface Controller
FSEU	Facilities, Systems, Equipment and Utilities
HVAC	Heating, Ventilating and Air Conditioning
ICS	Industrial Control System
ICSBR	Industrial Control System Backup Repository
IED	Intelligent Electronic Device
IOPSS	Ignition Overpressure and Sound Suppression
KCCS	Kennedy Complex Control System
OM&E	Operations Maintenance and Engineering
PDF	Portable Document Format
PWS	Performance Work Statement
SE	System Engineer
TAWS	Tornado Area Warning System
TechDoc	Technical Documentation Library
WON	Work Order Number

DEFINITIONS

Application Administrator: Individual responsible for the creation, modification and archiving of the source code and/or settings for a particular ICS. This role is assigned by IT through BOSS IT service request.

Gateway: A network device equipped for interfacing with another network that uses different protocols.

Industrial Control System (ICS): Microprocessor-based control system with user-configurable source code and/or settings that controls BOSS maintained (i.e. facility) systems.

Intelligent Electronic Device (IED): Micro-processor based controller that has the ability to communicate to a remote monitoring station on a control network. An IED typically does not have user-configurable source code but, instead, has user-configurable settings that can be modified by a built-in control panel.

Source Code: Computer system instructions that control the operation of the ICS, commonly known as software.

REVISION RECORD

The following revisions have been applied to this document:

Revision Number	Change Description	Date
0	Initial Release	05/06/11
1	Complete revision.	12/03/15
2	Updated to BOSS Format	02/05/20
3	Changed from SBU to CUI and formatting corrections	11/11/22

DOCUMENT APPROVALS

11/9/2022

X Pamela Krueger

Pamela Krueger
Manager, Engineering
Signed by: Pamela Krueger (affiliate)

[redacted]