



**CCP Status
to the
NASA Advisory Council
Human Exploration and Operations Committee**

**Kathryn Lueders
Manager
Commercial Crew Program**

November 5, 2015



NASA CCP Certification



- **CCP Certification/CoFR strives to achieve a balance of insight/oversight appropriate for shared government & industry accountability in establishing a safe, reliable, and cost-effective CTS**
 - The **Industry Partner** is responsible for the design, development, test and evaluation; culminating in their certification assertion of its CTS to transport crew to and from the ISS.
 - **NASA CCP** is accountable for **ensuring compliance** to CCP's human spaceflight requirements thru **evaluation and approval** of the Contractor's compliance evidence and execution of **NASA's insight** into the Contractor's solution in accordance with a risk based insight approach implemented under a shared assurance model.



Shared Accountability Balance

- **CCP Cert/CoFR activities based on shared accountability balance that acknowledges:**
 - Industry’s safety obligations in owning and operating CTS services for both government and private sectors
 - NASA’s critical obligations for assuring crew safety & mission success for NASA missions, relying on a shared assurance and risk based strategy





Government / Industry Accountability



Allocation of Responsibilities

Activity	NASA	Industry		
Design Cert	Establish Requirements	<ul style="list-style-type: none"> Flow down and Tailor Agency Rqmts (Mission Rqmts, HRR, Standards) Disposition Rqmts Variances 	<ul style="list-style-type: none"> Flow down of CCP Requirements and Tailoring; Evaluate Rqmts Achievability 	
	Manage Development Risk	<ul style="list-style-type: none"> Development Oversight Elevate Design and Development Risks from Insight 	<ul style="list-style-type: none"> Produce Mgmt Plans Perform Risk Reduction Planning 	
	Establish Cert Baseline	<ul style="list-style-type: none"> IV&V Accept Cert Compliance Support Joint Test Planning Accept Residual Risk 	<ul style="list-style-type: none"> Submit Cert Data Packages Perform System Validation Quantify Residual Risk (PSA, Reliability) 	
Flight Cert	Validate Baseline Cert	<ul style="list-style-type: none"> Quality Assurance Audits Accept Problem Resolutions 	<ul style="list-style-type: none"> Accept Hardware Problem Identification, Resolution, Corrective Actions 	CTS Certified
	Assess Mission Readiness	<ul style="list-style-type: none"> Accept Flight Certification and Residual Risk 	<ul style="list-style-type: none"> Compliance Evidence of Hardware/Team Readiness 	Flight Readiness Certification

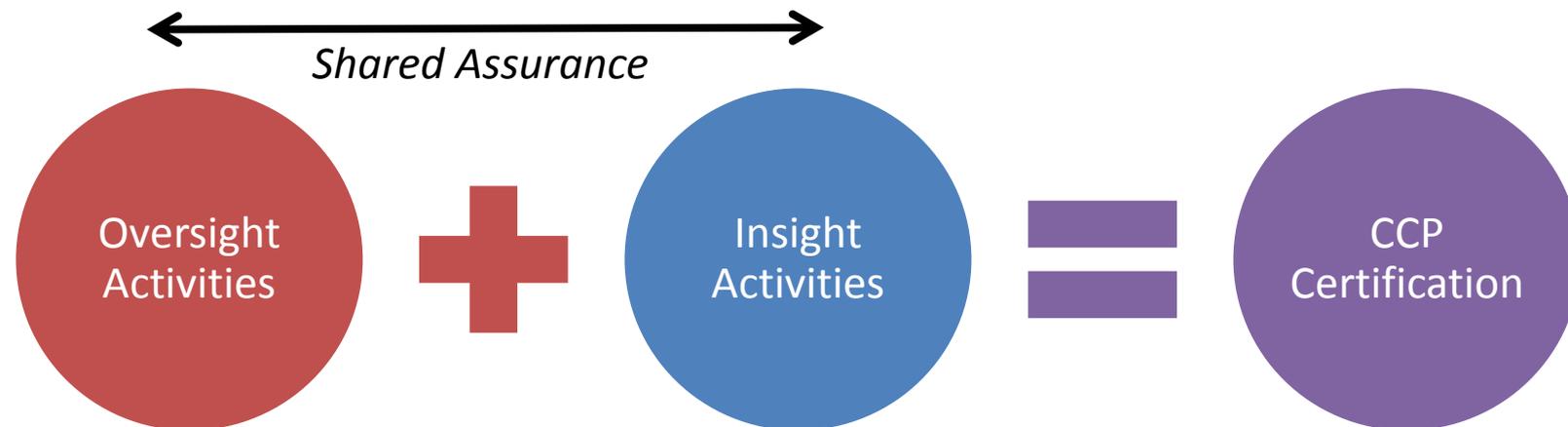
By design, the CCP model allocates greater accountability to industry.



Implementation of Insight/Oversight



- To meet the level of government assurance required to achieve Agency and Stakeholder confidence, NASA CCP performs a risk based approach to both Oversight and Insight Activities.
- The risk based CCP Certification approach achieves a balance of NASA insight/oversight appropriate for shared government & industry accountability in establishing a safe, reliable, and cost-effective CTS.



- Approval of Contractor Deliverables / Milestones

- Risk Based Insight
- Risk Based Assessment (RBA)
- Surveillance/Audits



CCP Certification Implementation



- **Key Components of NASA's Certification through design, development, test, production, and operations include:**
 - Certification Plan
 - Defines an integrated strategy for certification of the complete CTS and defines a structured and organized approach for implementing the strategy
 - Requirement Verification and Validation
 - Requirement Development
 - Verification and Validation Plans
 - Verification Closure Notices
 - Variances to NASA requirements
 - Specifications and Standards compliance
 - Phased Safety Reviews
 - Hazard Reports
 - Insight and Audits
 - Approval of Key Milestone Reviews and Deliverables



- **NASA CTS Certification is the approval of the Commercial Provider's evidence of:**
 - Compliance with the technical management processes requirements covered in Crew Transportation Technical Management Processes (CCT-PLN-1120)
 - Adherence to the technical standards in Crew Transportation Technical Standards and Design Evaluation (CCT-STD-1140) and the operational standards in Crew Transportation Operations Standards (CCT-STD-1150)
 - Compliance to the technical requirements in ISS Crew Transportation and Services Requirements (CCT-REQ-1130) and ISS to Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD) (SSP 50808)
- **The CCP and the ISS Program will approve of the Commercial Provider's compliance with the CTS requirements in ISS Crew Transportation and Services Requirements (CCT-REQ-1130). The ISS Program will approve of the Commercial Provider's compliance with the requirements in ISS to Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD) (SSP 50808).**



CCP Requirement Development

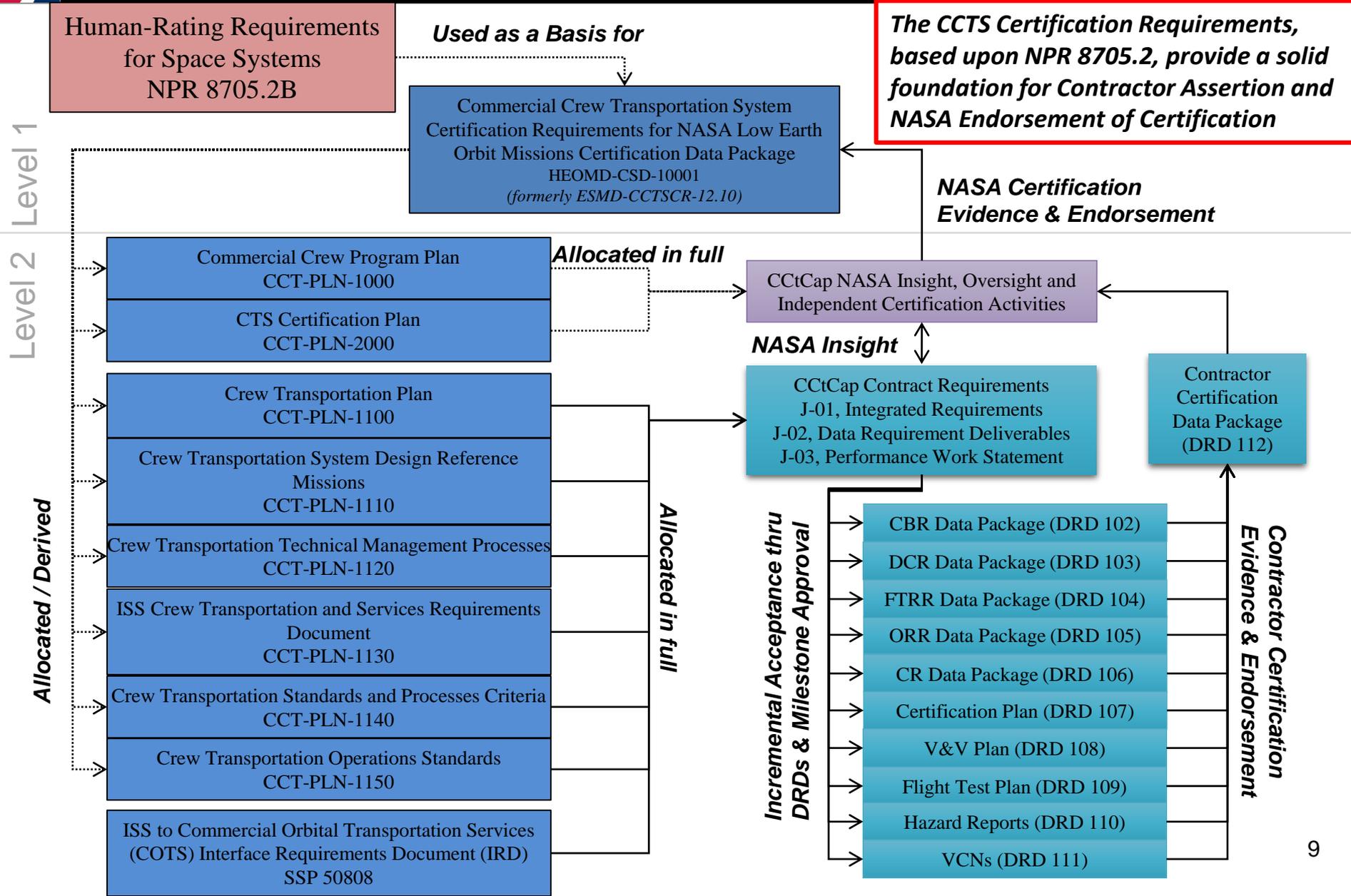


NPR 8705.2B Allocation to CCTS

- **Agency, HEOMD, and Program retain key accountability for NASA Human Spaceflight safety and mission success requirements allocated from NPR 8705.2B within overall NASA and industry shared accountability structure**
 - NPR 8705.2B was used as a basis in developing the HEOMD-10001 document, with applicable requirements flowed down to CCP Requirements documents, which have been levied on the CCtCap contract
 - The Human Rating Certification Package in NPR 8705.2B Appendix D represents a sub-set of the data required in the CCTS Certification Data Package defined in HEOMD-10001



CCTS Documentation Flowdown





CCT-REQ-1130



Purpose and Mapping

- **CCT-REQ-1130 contains:**

- Performance requirements in meeting the ISS DRM documented in CCT-PLN-1110
- Human rating requirements allocated from NPR 8705.2B (trace shown below)

NPR 8705.2B Human-Rating Technical Requirements (Chapter 3)		→ Maps to HEOMD-10001 Requirement	→ Allocated to CCT-REQ-1130 Requirement	
Key	Title	Key	Key	Title
3.2.1	Crew Environment	5.2.1	3.10 (and subs)	Human Health, Medical and Performance
			3.2.5.11	Pressure Suits
3.2.2	Probabilistic Safety Criteria	5.2.2	3.2.1.1	Loss of Crew Risk
			3.2.1.2	Loss of Mission Risk
3.2.3	Failure Tolerance	5.2.3	3.2.3.1	Failure Tolerance to Catastrophic Events
				Separation of Redundant Systems
3.2.4	Failure Tolerance without Emergency Equipment	5.2.4	3.2.3.2	Failure Tolerance without Aborts
3.2.5	Tolerate Inadvertent Operator Action	5.2.5	3.8.5.1.2	Tolerate Inadvertent Action
3.2.6	Tolerate Inadvertent Operator Action during Failure	5.2.6	3.8.5.1.4	Tolerate Inadvertent Action during Failure
3.2.7	Critical Software Control Detect and Annunciate	5.2.7	3.9.2.1	Software Engineering Requirements
3.2.8	Faults	5.2.8	3.2.4.1	Detect and Annunciate Faults

NPR 8705.2B Human-Rating Technical Requirements (Chapter 3)		→ Maps to HEOMD-10001 Requirement	→ Allocated to CCT-REQ-1130 Requirement	
Key	Title	Key	Key	Title
3.2.9	Isolate and Recover from Faults	5.2.9	3.2.3.4	Isolate and Recover from Faults
3.2.10	Health and Status Data	5.2.10	3.2.4.2	Record and Display Health and Status
3.2.11	Autonomous Operation of System	5.2.11	3.2.6.3	Autonomous Operation of System
3.2.12	Access Emergency Equipment	5.2.12	3.2.5.1	Access Emergency Equipment
3.3.1	Crew Control of Vehicle	5.3.1	3.8.5.1.1	Crew Control of Vehicle
3.3.2	Manually Override Software	5.3.2	3.2.6.1	Manually Override Software
			3.2.6.2	Manually Override Software - Post-Separation
3.3.3	Ground Monitoring and Operation	5.3.3	3.7.1	Ground Monitoring and Operation
3.4.1	Manual Control of Vehicle Flight Path	5.4.1	3.8.4.1	Manual Control of Vehicle Flight Path
			3.8.4.2	Manual Piloting for Docking
3.4.2	Handling Qualities	5.4.2	3.8.4.3	Handling Qualities

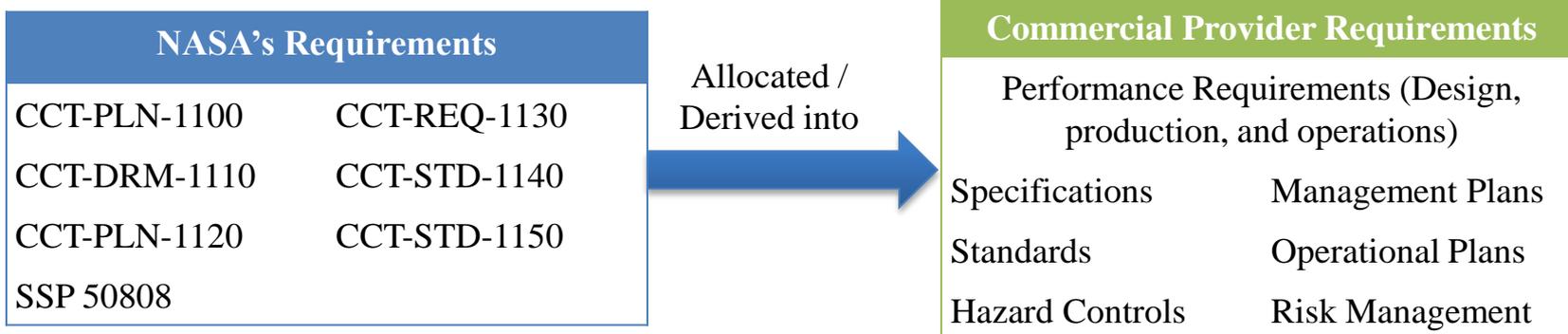
(Remaining trace in backup)



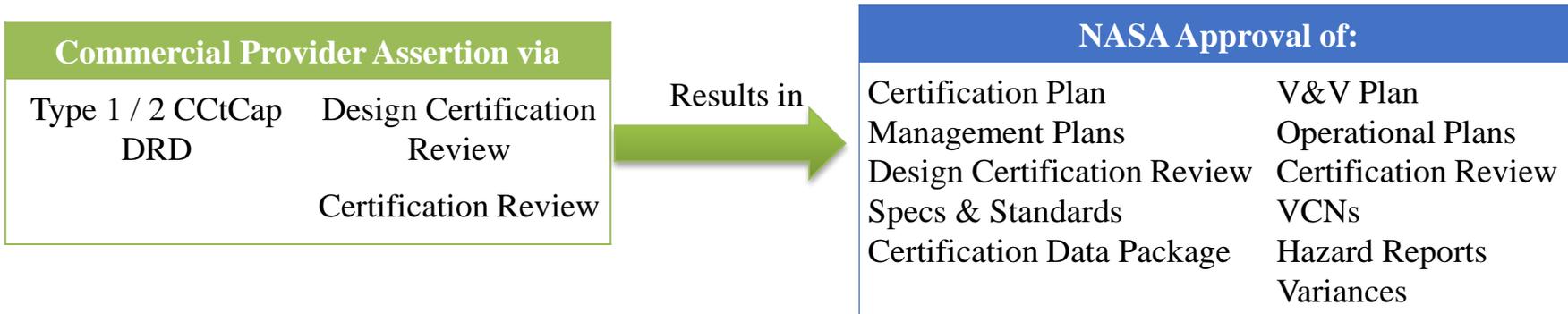
Commercial Partner Certification Assertion



- The **CCP Certification** builds upon the requirements levied on the **CCtCap contract**:
 1. A Commercial Provider develops a CTS and asserts that it meets NASA's safety, crew, and technical requirements and that it is managed to an acceptable level of risk for transporting NASA crew.



2. The CCP **substantiates the Commercial Provider's assertion.**





- **CCT-REQ-1130 requirements are the requirements set for the entire CTS from launch through landing while independent of ISS**
- **SSP 50808 is an over-arching Interface Requirements Document for ISS**
 - Covers CRS and Commercial Crew
 - Contains requirements that are necessary for the docking or berthing to the ISS
 - Contains requirements governing the visiting vehicle within the 4 x 2 x 2 km approach ellipsoid around ISS
 - Contains requirements for the vehicle as docked to ISS
 - Day to day living and activities as part of station
- **Standards**
 - All standards for both documents have been reviewed and are the same or complimentary.
 - An example of complimentary are the two fracture control standards. One is for the broad scope of the system and the other is ISS specific:
 - NASA-STD-5019 for system fracture control
 - SSP 30558 for ISS specific fracture control
- **Variances**
 - Variances can be submitted for both CCT-REQ-1130 and SSP 50808 requirements
 - All variances will be reviewed and approved through the appropriate Program Board structure
- **Requests for variances to SSP 50808 processed in accordance with ISSP Board Structure**
- **ISS Integration is based on successful visiting vehicle integration both with International Partners and Commercial Resupply Services (CRS)**



CCP Specifications and Standards



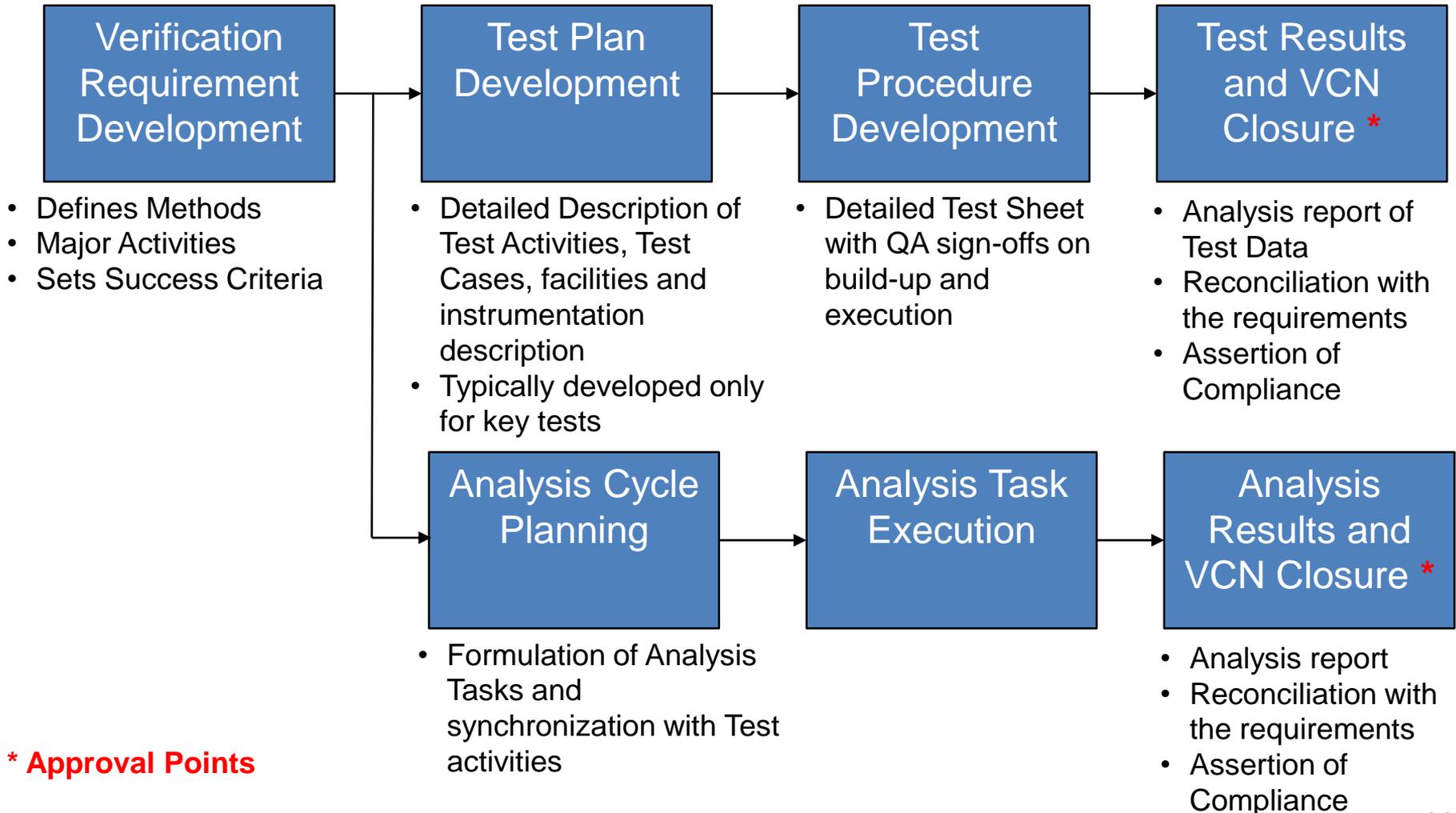
- **Subset of the 1130 & 50808 requirements pertain to specifications and standards**
- **One type of standard must be followed completely with no deviation or alternative proposal.**
 - They are identified by the words “meet” within the corresponding sections of the documentation.
- **The majority of the standards identified are standards which use the language “meet the intent of.”**
 - These contain requirements that can be met explicitly by following the standard or by proposing alternate standards that meet or are consistent with the requirement levied in the NASA Standard
 - Providers are allowed to provide alternate standards that meet the intent of the NASA requirement.
 - These alternate standards are delivered to NASA for formal assessment.
- **There are many other standards that may be utilized in the design and manufacturing process and for standard operations.**
 - These are the third type of standard and many of these can be found in the reference documents section.



Verification Development Flow



V&V Plan* Detailed Planning





NASA Phased Safety Review Requirements



- **Phased safety review process is levied through CCT-PLN-1120, various SSP documents, and the tCap contract**
 - Ensures that there are adequate controls for catastrophic hazards
 - Given the high-level requirements from CCP & ISS, the tCap partners must derive their own detailed requirements for these controls
 - Also serves as the basis for verifying significant requirements in CCT-REQ-1130
 - Hazards that can effect the ISS are reviewed jointly with the established ISS Visiting Vehicle Safety Review Panel (SRP) and the CCP Safety Technical Review Board (STRB)
- **In accordance with CCT-PLN-1120 and SSP 30599, NASA Phased Safety Reviews will be conducted in three phases:**
 - Phase I will be conducted in a timeframe consistent with a Preliminary Design Review (PDR) (during CPC)
 - Phase II will be conducted in a timeframe that is consistent with a Critical Design Review (CDR) level of maturity (currently in work)
 - Phase III will be conducted in a timeframe that is consistent with a DCR level of maturity
 - Phase III includes the incremental closure of all the verification activities for the controls identified in hazard reports
- **The scope of the safety reviews is to determine, given a Commercial Provider's solution, that analysis was conducted to the appropriate level to surface key risks in the design and whether risks exist beyond the requirements established for certification**
 - Results are intended to inform the design and program reviews and establish the level of acceptable risk for the system
 - Any requirement non-compliances or accepted risk outside the STRB is forwarded to the CCP/ISS Program Boards for acceptance

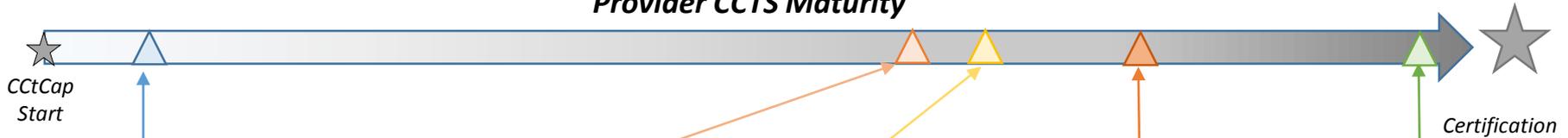


Key Certification Milestones



- **CCtCap designated the following Mandatory Interim Milestones to review and/or approve the Contractor's progress toward Certification**

Provider CCTS Maturity



Certification Baseline Review (CBR)

Objectives:

- Identification of baseline requirements and current CTS design baseline;
- Document management plans and products;
- Define the plan and schedule to complete DDTE and Certification;
- Define top safety, technical, cost, and schedule risks

ISS Design Certification Review (DCR)

Objectives:

- Demonstrate that the CTS and operations meet all **applicable** requirements;
- Provide evidence of requirement compliance through implementation of its baselined management and certification plans;
- Demonstrate schedule performance;
- Define top safety, technical, cost and schedule risks

Flight Test Readiness Review (FTRR)

Objectives:

- Demonstrate readiness to conduct a crewed flight test;
- Define a risk baseline for crewed flight test activities

Operations Readiness Review (ORR)

Objectives:

- Demonstrate that the actual CTS system characteristics and procedures used in operations reflect the deployed state of the CTS;
- Evaluate all project and support (flight and ground) hardware, software, personnel, and procedures to ensure flight and associated ground systems are in compliance with program requirements and constraints

Certification Review (CR)

Objectives:

- Provide evidence that the CTS has met all NASA requirements in Attachment J-01;
- Provide documentation of crew safety and mission assurance risks associated with the CTS



- **CTS Certification is the approval of the Commercial Provider's evidence that all tests/analyses/verification and validation proves that the baseline design meets the requirements (e.g. reference configuration)**
 - CTS Certification will be incrementally approved through Oversight and Risk Based Insight in parallel to CCtCap Certification related milestones (i.e. Uncrewed Flight Test DCR, Crewed Flight Test DCR, ORR, and CR)
 - To support this CTS Certification process, CCP SE&I will revise the existing Certification Plan (CCT-PLN-2000) to include the Certification endorsements and sub-endorsements
- **CTS CoFR refers to the NASA endorsement that compares and validates the hardware built and any issues uncovered to the reference certified configuration**
 - CTS CoFR will be incrementally approved through Oversight and Risk Based Insight in parallel to CCtCap Flight Readiness milestones: (i.e. Uncrewed Flight Test FTRR, Crewed Flight Test FTRR, and PCM FRRs)
 - To support this CTS CoFR process, CCP SE&I will create the CCP CoFR Plan (CCT-PLN-2100) to document the overall philosophy, roles and responsibilities and CoFR endorsements and sub-endorsements.



Certification / CoFR Structure and Forward Plan



- **CCT-PLN-2000 and CCT-PLN-2100 will cover the overall CTS Certification approval and CoFR endorsement throughout the Agency**
 - Certification approvals and CoFR endorsements will include:
 - Both CCP and ISSP Program Managers
 - CCP System Office Managers
 - ISS Office Managers, as required by SSP-50108 (CoFR endorsements only)
 - The Chief of each Technical Authority (Engineering, S&MA, HH&P) and FOD Manager
 - AA HEOMD is the ultimate approval authority for both Certification and CoFR
- **The Certification and CoFR Plans are Partner Independent**
- **The end goal is to have the revised CCT-PLN-2000 and new CCT-PLN-2100, along with the supporting tasks for those plans, baselined by December**



Summary



- **CCP**
 - Continues to work with both Providers on maturing their designs
 - Establishing the NASA expectations for both the CCP Certification Plan and Certification of Flight Readiness Plans
- **Both Providers**
 - Are meeting contractual milestones
 - Are progressing through the Phase II Safety Reviews
 - Are working detailed Verification and Validation planning
 - Are maturing their detailed designs
 - Are providing increased insight opportunities for the NASA team
 - Have advanced beyond paper products and are building and testing hardware
- **They, and we, have a great deal of work in front of us.**