Configuration Management within the Digital Engineering Environment (DEE)

SPEC INNOVATIONS

BLUF

- Configuration Management (CM) within a DEE requires capabilities for configuration baselining, change management, and configuration control
- Change management includes:
  - Defining configuration controlled changes
  - Identifying, reviewing, and approving/disapproving proposed changes
  - Implementing and verifying approved changes
  - Retaining change records
- Multiple ways to implement Change Requests within a DEE; varying levels of benefit and implementation effort

Contents

- Configuration Management (CM)
- Managing Change
  - Enabling Capabilities
  - Document Change Management
  - Architecture Change Management
  - Configuration-Controlled Change Policy
- Data Retention
- Implementing Change Requests

Configuration Management (CM)

- Configuration Management is addressed in an organization's Systems Engineering Plan (SEP) and Configuration Management Plan (CMP)

BASELINE

- NIST SP 800-53[1] CM-2 defines baseline configurations as "documented, formally reviewed, and agreed-upon specifications" which "serve as a basis for future builds, releases, or changes"
- NIST SP 800-53[1] CM-3 states that configuration change control includes:

DEFINE
- Determining and documenting the types of changes that are configuration-controlled

REVIEW
- Reviewing and approving/disapproving configuration-controlled changes

DECIDE
- Documenting configuration-controlled change decisions

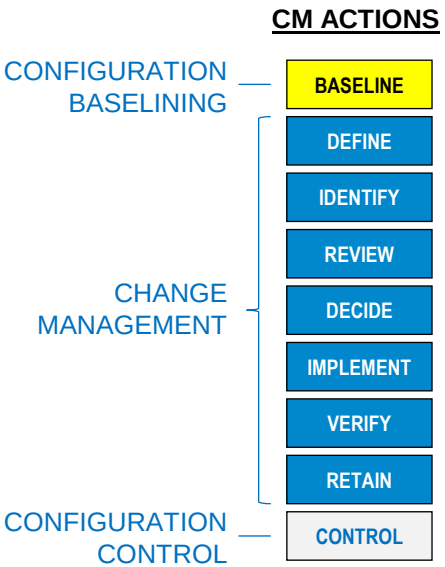
IMPLEMENT
- Implementing approved configuration-controlled changes

VERIFY
- Monitoring and reviewing configuration-controlled changes

RETAIN
- Retaining records of configuration-controlled changes

- Configuration Management of DEE content involves:

CONTROL
- Organizational CM Processes, Forms, and Tools
- DEE Project and Entity Access Controls
- DEE Document Baselining



[1] U.S. Department of Commerce, NIST SP 800-53, Rev. 5 Security and Privacy Controls for Information Systems and Organizations § (2020).

Managing Change

BASELINE

- Baseline
  - Any approved configuration within the DEE (e.g., Specification, Functional Architecture, Physical Architecture)
  - Includes specified DEE entities and relationships
  - Requires formal process for modification

IDENTIFY

- Change Request (CR) / Engineering Change Proposal (ECP)
  - Identifies proposed baseline change within the DEE
  - Establishes impact of proposed baseline change
  - Documents steps to implement proposed baseline change within the DEE
- Change Control Board (CCB)

REVIEW

  - Reviews impacts of proposed baseline changes

DECIDE

  - Approves or disapproves proposed baseline changes
  - Documents decisions

IMPLEMENT

  - Issues implementation directive for proposed baseline changes

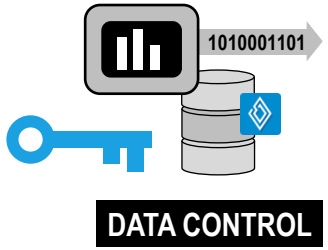
Enabling Capabilities
DEE Data Controls

- DEE should employ multiple data control mechanisms that can be used to prevent unauthorized data modifications

CONTROL
- Project Access Permissions
  - Segregation of data across projects allows different users and user groups to have permissions (e.g., edit, review, view) appropriate to the program phase
  - Requires upfront planning in conjunction with the development of a Conceptual Data Model (CDM)

BASELINE
- Document Baselining
  - Leverages entity history to capture and store document baselines (i.e., snapshots in time)
  - Modifications to baseline, but not entities, prevented
  - Does not prohibit document deletion

CONTROL
- Entity Locking
  - Prevents changes to entity attributes, labels, and relationships while locked
  - Entities can only be unlocked by the locking collaborator or project owners



DATA CONTROLS

DEE should employ a tiered data management approach.

Level	Control Mechanism(s)
Macro	Project Access Permissions
Document	Baselining, Entity Locking
Micro	Entity Locking

Timeframe	Project	User [Permission]
Initial	System	Developer SE Team [Collaborator] Developer Non-SE User [Collaborator] Customer [Reviewer]
Post-PDR	System	Developer SE Team [Collaborator] Developer Non-SE User [Reviewer] Customer [Reviewer]

NOTIONAL PROJECT ACCESS PERMISSIONS

Enabling Capabilities
DEE Change Requests

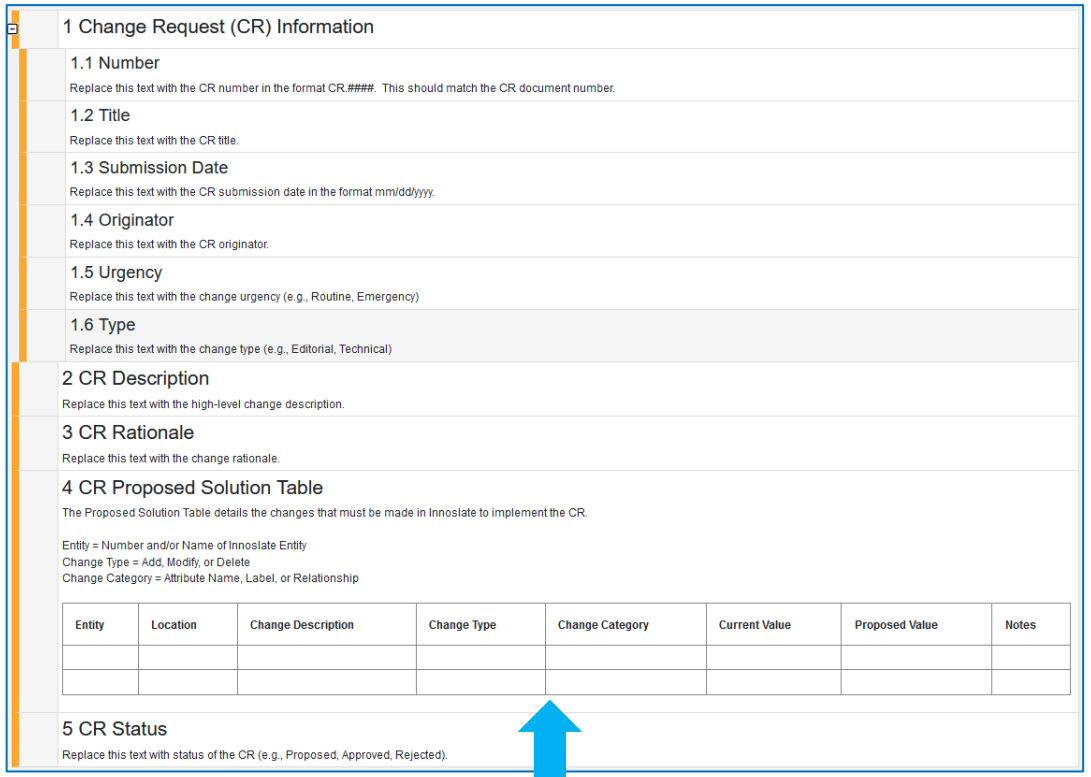
IDENTIFY

- Option 1: DEE-based CR/ECP
  - Create CR/ECP form as a rendered document
    - Include section for capturing proposed step-by-step DEE changes
    - Use as basis for a custom template
  - New CR/ECP
    - Create new CR/ECP from custom template
    - Renumber Artifact and CR/ECP entities with new prefix (e.g., “CR.0023.”)
    - Baseline CR/ECP after each stage (e.g., following submittal, following CCB review)
- Option 2: Attach Excel CR/ECP to Artifact
- Consider creating an Artifact subclass with an enumerated status field to allow implementation of CR/ECP workflow

DECIDE

- CCB decisions can be captured within the CR/ECP form or using related Decision entities (i.e., Decision ‘enabled by’ Artifact)

DEE CHANGE REQUEST FORM



1 Change Request (CR) Information

1.1 Number
Replace this text with the CR number in the format CR.####. This should match the CR document number.

1.2 Title
Replace this text with the CR title.

1.3 Submission Date
Replace this text with the CR submission date in the format mm/dd/yyyy.

1.4 Originator
Replace this text with the CR originator.

1.5 Urgency
Replace this text with the change urgency (e.g., Routine, Emergency)

1.6 Type
Replace this text with the change type (e.g., Editorial, Technical)

2 CR Description
Replace this text with the high-level change description.

3 CR Rationale
Replace this text with the change rationale.

4 CR Proposed Solution Table
The Proposed Solution Table details the changes that must be made in Innoslate to implement the CR.

Entity = Number and/or Name of Innoslate Entity
Change Type = Add, Modify, or Delete
Change Category = Attribute Name, Label, or Relationship

Entity	Location	Change Description	Change Type	Change Category	Current Value	Proposed Value	Notes

5 CR Status
Replace this text with status of the CR (e.g., Proposed, Approved, Rejected).

STEP-BY-STEP DEE CHANGES

Document Change Management

- Rendered documents include specifications and plans
  - Consist of hierarchically sequenced Statement and Requirement entities
  - BASELINE Baseline with DEE's document baselining features
  - CONTROL Restrict editing through project permissions and/or entity locking
- Managing Change
  - DEFINE Define in policies the types of document changes that are configuration-controlled at a given point in time
    - Ex. Post-PDR: Requirement names, numbers, descriptions, and rationales are configuration-controlled
    - Ex. Post-CDR: Requirement names, numbers, descriptions, rationales, and relationships are configuration-controlled
  - IDENTIFY Configuration-controlled changes to document entities detailed in CR/ECP
  - IMPLEMENT CCB approved CR/ECP implemented by authorized modifier
  - VERIFY CM personnel should review Post Baseline Change Reports (PBCRs)
    - PBCRs provide a detailed log of all changes occurring to a document's entities following each baseline
    - PBCRs should be compared against approved CRs/ECPs
    - Erroneous or unauthorized changes should be backed out and logged

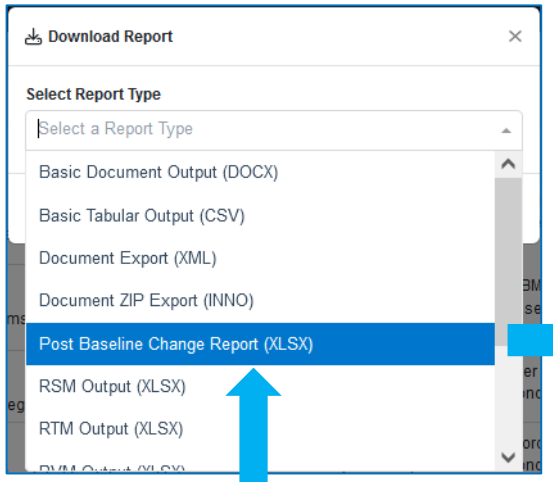
Document Change Management

Post Baseline Change Report (PBCR)

VERIFY

- PBCRs provide a detailed log of all changes occurring to a document following each baseline
  - Access from ‘Reports’ menu within rendered document
  - Tab names correspond to baseline names
  - Tabs show baseline entity content and any changes made prior to the next baseline

DOCUMENTS VIEW REPORTS



SELECT POST BASELINE CHANGE REPORT

BASELINE ENTITY CONTENT

POST BASELINE CHANGES

Post Baseline Change Report | Artifact: Vitals Station Component Specification (CS) | Baseline: V.1.0 Initial | Date: 2024-04-01 05:08 PM

Global ID	ID	Number	Name	Description	Rationale	Labels	Comments	Version	Date	User	Change Type	Change Value
I_F7DCN0AD84H39_94BAWT9RJFPVD	127962	VS.CS.1	Vitals Data Measurements									
I_8E11HHCKWEKMB_B7ZZNWKEK9S3Q	127958	VS.CS.1.1	Height Measurement	The vitals station shall measure the patient's height in inches.	Patient height required as input to			2	2024-04-01 05:15 PM		DESCRIPTION changed to	The vitals station shall measure the patient's height in centimeters (cm).
I_B4E47PG29MKK0_A80PP8G92SH8M	127960	VS.CS.1.2	Weight Measurement	The vitals station shall measure the patient's weight in pounds (lbs).	Patient weight required as input to			2	2024-04-01 05:15 PM		DESCRIPTION changed to	The vitals station shall measure the patient's weight in kilograms (kg).
I_EWGR09J0VJJFH_BXT9D6GN7QKV5	127959	VS.CS.1.3	Temperature Measurement	The vitals station shall measure the patient's temperature in degrees	Patient temperature required in order to			2	2024-04-01 05:15 PM		DESCRIPTION changed to	The vitals station shall measure the patient's temperature in degrees Celsius.
I_EXSGZNVQT8HJK_BJXP912D87X2Y	127953	VS.CS.1.4	Blood Pressure Measurement	The vitals station shall measure the patient's blood pressure (systolic/diastolic	Patient blood pressure required in							
I_6V3YY128P6KV5_9B42YRZNNPFDA	127957	VS.CS.1.5	Heart Rate Measurement	The vitals station shall measure the patient's heart rate in beats/min.	Patient heart rate required in order to							
I_DNM5XEEDTRGHM_B7KDSZS798JGJ	127956	VS.CS.2	Vitals Data Measurement	The vitals station shall capture vitals data in under 6 min for 80% of patients.	In order to maintain clinic throughput,							
I_H22WA4N74GJV_8BWP6YFC2QGE6	127961	VS.CS.3	Vitals Station Disinfection	The vitals station shall keep measuring equipment in a disinfected state between	Failure to maintain disinfection may							
I_57C7WTQXVEKTK_BS8T8D04020XC	127952	VS.CS.4	Vitals Station Power	The vitals station shall operate off of 120V AC / 60 Hz power.	120V AC / 60 Hz power is the standard							

V.1.0 Initial | V.1.1 Metric

BASELINE TABS

POST BASELINE CHANGE REPORT (PBCR)

Architecture Change Management

- Architectures include any set of related DEE entities
  - Typically include entities supporting physical, functional, or hierarchical models
  - May align to DoDAF or UAF Viewpoints
- BASELINE
  - Baseline through management declaration
- CONTROL
  - Restrict editing through project permissions and/or entity locking
- Managing Change
- DEFINE
  - Define in policies the types of architecture changes that are configuration-controlled at a given point in time
    - Ex. Post-PDR: System/subsystem Asset names, numbers, and descriptions are configuration-controlled
    - Ex. Post-CDR: System/subsystem Asset names, numbers, descriptions, and relationships are configuration-controlled
- IDENTIFY
  - Configuration-controlled changes to architecture entities detailed in CR/ECP
- IMPLEMENT
  - CCB approved CR/ECP implemented by authorized modifier
- VERIFY
  - CM personnel should review CR/ECP project modifications
    - Entities should be compared against approved CRs/ECPs
    - Erroneous or unauthorized changes should be backed out and logged

Configuration-Controlled Change Policy

- Configuration-Controlled Change Policy defines the types of changes that are configuration-controlled at a given point in time

Timeframe	Item	Configuration-Controlled Changes
Post-PDR	SRD Requirement	Name, Number, Description, Rationale; 'refines' Relationship
	Functional Model Actions	Name, Number, Description
	System/Subsystem Assets	Name, Number, Description
Post-CDR	SRD Requirement	Name, Number, Description, Rationale; 'refines', 'refined by', 'traced to' Relationships
	SSS Requirement	Name, Number, Description, Rationale; 'refines' Relationship
	Functional Model Actions	Name, Number, Description; 'generates', 'performed by', 'receives', 'traced from' Relationships
	System/Subsystem Assets	Name, Number, Description; 'connected to', 'performs' Relationships

NOTIONAL CONFIGURATION-CONTROLLED CHANGE POLICY

Data Retention

BASELINE

- Retain baselined products in the organization's CM system
  - Documents
    - Retain externally viewable document by generating DOCX report
    - Retain products necessary to automatically reconstruct document
      - Backup files with baseline option selected
      - CSV spreadsheets with IDs and cross-project relationships
  - Architectures
    - Retain products necessary to automatically reconstruct architecture
      - Backup files with baseline option selected
      - CSV spreadsheets with IDs and cross-project relationships
    - Consider retaining visual representations of key architectural areas, including hierarchies of diagrams

RETAIN

- Retain records of configuration-controlled changes
  - DEE-based CR/ECP Documents
    - Retain externally viewable documents by generating DOCX reports

Implementing Change Requests

- Change Request (CR)
  - DoD refers to as an Engineering Change Proposal (ECP)
  - Identifies proposed baseline change within DEE
  - Establishes impact of proposed baseline change
  - Documents steps to implement proposed baseline change within DEE
- Multiple ways to implement CRs within DEE; varying levels of benefit and implementation effort
  - Option 1: DEE-based CR
    - CR form implemented as rendered document
    - Option 1a – Contains textual Proposed Solution Table
    - Option 1b – Contains dynamically constructed Proposed Solution Table
  - Option 2: Attach Excel CR to Artifact

CR IMPLEMENTATION OPTION BENEFITS AND EFFORT

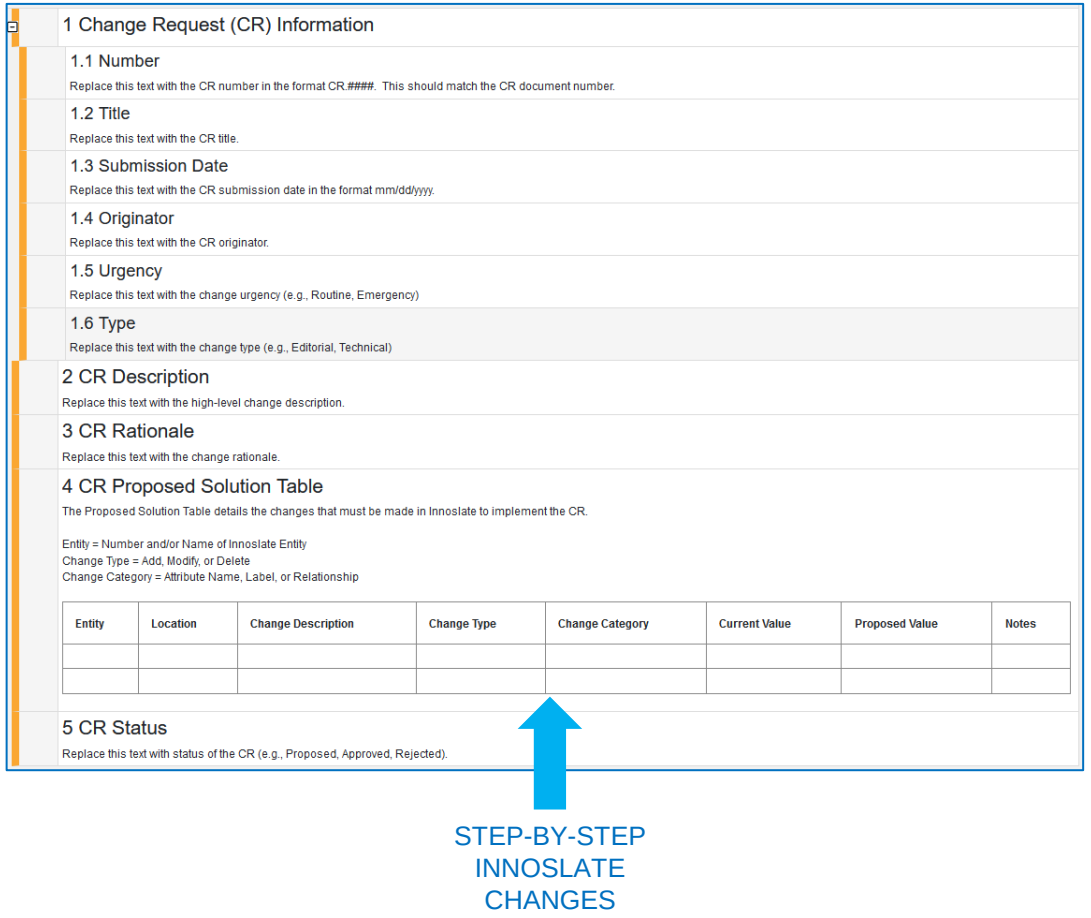
	CR Implementation			
	Option 1a	Option 1b	Option 2	
Benefits	X	X	X	Captures CR as Relatable DEE Entity
	X	X	X	Facilitates DEE CR Workflow
	X	X		CR Baselining
	X	X		No Reliance on External Tools
		X		Captures Solution Steps as Relatable DEE Entities
		X		Dynamically Constructed Proposed Solution Table
		X		Proposed Solution Table Exportable as Spreadsheet
Effort			X	Develop Excel CR Form
	X	X		Develop CR Document Template
		X		Modify CR Document Entity Table Query
		X		Update Schema for Solution Steps
		X		Establish Solution Step Database Query
	Low	Medium	Very Low	End User Training

Implementing Change Requests

Change Request Elements

- Key elements of a CR include:
  - Information – provides administrative information on the CR to include:
    - Number
    - Title
    - Submission Date
    - Originator
    - Urgency – Routine, Emergency
    - Type – Editorial, Technical
  - Description – provides a high-level description of what the change will accomplish
  - Rationale – describes why it is necessary to implement the change
  - Proposed Solution Table – provides detailed steps for implementing the CR in DEE
  - Status – describes the location within the CR workflow
- CR elements tailored to match user format

INNOSLATE CHANGE REQUEST FORM



STEP-BY-STEP INNOSLATE CHANGES

Implementing Change Requests

Proposed Solution Table

SOLUTION STEPS

PROPOSED SOLUTION TABLE

Entity Information	Location	Change Description	Change Type	Change Category	Current Value	Proposed Value	Notes
VS.CS.1.1 Height Measurement	https://cloud.innoslate.com/training/p/626/database/entity/127958	Convert description units to metrics.	Modify	Description	The vitals station shall measure the patient's height in inches.	The vitals station shall measure the patient's height in centimeters (cm).	
VS.CS.1.2 Weight Measurement	https://cloud.innoslate.com/training/p/626/database/entity/127960	Convert description units to metrics.	Modify	Description	The vitals station shall measure the patient's weight in pounds (lbs).	The vitals station shall measure the patient's weight in kilograms (kg).	
VS.CS.1.3 Temperature Measurement	https://cloud.innoslate.com/training/p/626/database/entity/127959	Convert description units to metrics.	Modify	Description	The vitals station shall measure the patient's temperature in degrees Fahrenheit.	The vitals station shall measure the patient's temperature in degrees Celsius.	

ENTITY INFORMATION
Contains the entity's number and/or name.

LOCATION
Contains the entity's URL.

CHANGE DESCRIPTION
Contains a description of the change to the entity.

CHANGE TYPE
Specifies the type of change to include: Add, Modify, or Delete.

CHANGE CATEGORY
Specifies the entity attribute name, label, or relationship to be changed (e.g., Name, Description, Label, Relationship).

CURRENT VALUE
Contains the current value associated with the Change Category, if applicable.

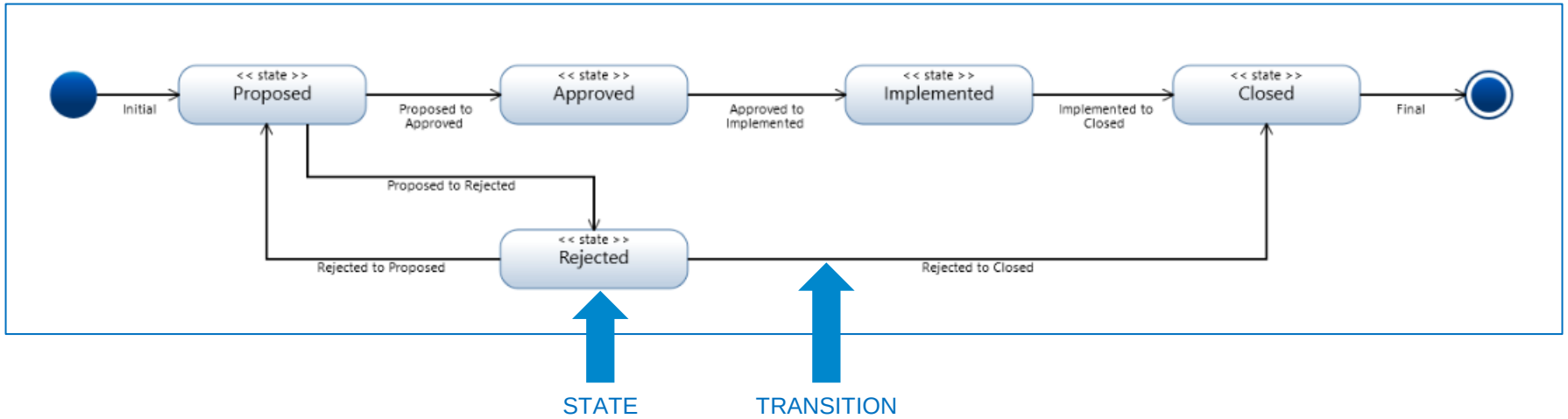
PROPOSED VALUE
Contains the proposed value associated with the Change Category.

NOTES
Contains any additional explanatory notes to clarify the proposed change.

Implementing Change Requests
CR Workflow

- CR workflow can be modeled as a State Machine Diagram (SMD)
- Implement SMD in DEE schema
  - Create ‘Change Request’ class with states mapped to an enumerated status field
  - Create ‘Change Request Status’ workflow to implement state transitions

CHANGE REQUEST WORKFLOW STATE MACHINE DIAGRAM



Summary

- Configuration Management (CM) within a DEE requires capabilities for configuration baselining, change management, and configuration control
- Change management includes:
  - Defining configuration controlled changes
  - Identifying, reviewing, and approving/disapproving proposed changes
  - Implementing and verifying approved changes
  - Retaining change records
- Multiple ways to implement Change Requests within a DEE; varying levels of benefit and implementation effort