Nuclear Facility
Configuration Management
Survival Guide

Revision 9

CONFIGURATION MANAGEMENT

BENCHMARKING GROUP

CMBG Survival Guide

Foreword

This document was originally prepared for the 1999 CMBG conference.

In its current form there are entries and explanations not vetted in official documents or guidance. The information is presented to assist the CM practitioner in understanding concepts and relationships.

While every effort was made to keep it accurate and complete, there may be errors or omissions. For corrections or suggestions on next year's Survival Guide, please contact the CMBG Committee.

Visit our website at www.cmbg.org for more information and links to other nuclear CM-related sites.

Rev. 9 - Updates to the CMBG Conference Hosting History, Events, ANSI Standards, INPO Documents, NEI Documents, NRC Documents, Facility Configuration Information, CM Relationships, Applying a Graded Approach, Acronyms, and Abbreviations, Steering Committee members, and Delivering the Nuclear Promise. Added supporting information to the CMBG website related to the Fukushima 2011 disaster a NEA link to SMR designs.

CMBG Survival Guide

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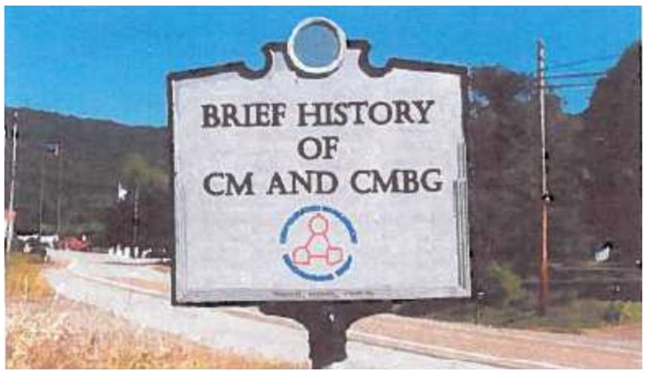
CMBG Survival Guide

CMBG Conference Hosting History

Year	Host	Location
1994	PP&L	Poconos, Pennsylvania
1995	Ontario Hydro	Niagara-on-the-Lake, Ontario
1996	Houston Light & Power	Galveston, Texas
1997	Commonwealth Edison	Chicago, Illinois
1998	North Atlantic Energy Service Co.	Boston, Massachusetts
1999	Duke Power	Charlotte, North Carolina
2000	Consolidated Edison	Tarrytown, New York
2001	Carolina Power & Light	Raleigh, North Carolina
2002	PSEG Nuclear LLC	Atlantic City, New Jersey
2003	PPL Susquehanna LLC	Hershey, Pennsylvania
2004	Wolf Creek Nuclear Operating Corp	Kansas City, Missouri
2005	FirstEnergy Nuclear Operating Corp	Cleveland, Ohio
2006	Dominion Generation	Richmond, Virginia
2007	SCE&G	Charleston, South Carolina
2008	Pacific Gas & Electric	Shell Beach, California
2009	Entergy	Boston, Massachusetts
2010	Duke Energy	Charlotte, North Carolina
2011	PSEG Nuclear LLC	Philadelphia, Pennsylvania
2012	Exelon Nuclear	Chicago, Illinois
2013	Southern Nuclear	Atlanta, Georgia
2014	Energy Northwest	Seattle, Washington
2015	Arizona Public Service	Glendale, Arizona
2016	NextEra Energy	West Palm Beach, Florida
2017	Ameren Corporation	St. Louis, Missouri
2018	Tennessee Valley Authority (TVA)	Chattanooga, Tennessee
2019	Southern Nuclear	Orlando, Florida
2020	PKMJ Technical Services LLC	Virtual Online
2021	PKMJ Technical Services LLC	Virtual Online
2022	Westinghouse Electric Company LLC	Pittsburgh, Pennsylvania
2023	Arizona Public Service	Phoenix, Arizona
2024	Sargent &Lundy	Chicago, Illinois
2025	Evergy	Kansas City, Missouri
2026	Southern Nuclear	Orlando, Florida

Brief History of CM and CMBG



Configuration Management (CM) existed to varying degrees in the military, at NASA, and in aerospace/aircraft industries since the 30’s and 40’s. CM in these industries was geared towards product conformance to facilitate interchangeability of parts while still satisfying the overall design requirements.

Nuclear plants in the mid-60’s to early 80’s were typically designed by AEs under contract. Final design documents typically were turned over to the utility at the end of construction, with little knowledge transfer of design information to the utility engineering organization. Utilities struggled to deal with long-term design maintenance and related document upkeep.

Listed below are some of the early indicators that the nuclear plant design basis knowledge was becoming disconnected from the physical plant and the documentation:

- **NRC IE Bulletin 79-14** was issued to address disconnects between piping and support analyses and the as-built configuration.
- **Salem NPP Anticipated Transient Without Scram event (1983)** which resulted in safety equipment nor performing as required. Analysis of the event identified problems with the utility not following vendor recommendations, part and procurement issues, and vendor manual controls.
- **Davis Besse Loss of Feedwater event (1985)** that pointed our difficulties maintaining operational readiness of safety systems and a lack of understanding design basis. This event resulted in increased NRC focus through Safety System Functional Inspections (SSFI) and most utilities undergoing design basis reconstitution projects.
- **Millstone Spent Fuel Pool Cooling event (1996)** which resulted in NRC losing confidence in the utility’s ability to know and maintain its design basis to implement design and licensing requirements. 10 CFR 50.54 (f) letter in October 1996 to all licensees that required a response on how design basis information was controlled and maintained.

These events created several industry responses including:

- **Nuclear Information Records Management Association (NIRMA)** produced several documents related to CM and design basis.
- **Nuclear Utilities Management & Resources Council (NUMARC)** which became Nuclear Energy Institute (NEI) issued guidance documents on establishing and understanding design basis.
- **CMBG** was formed in October 1994 and has emerged as the CM Community of Practice within the U.S. CMBG was instrumental in assisting other codes and standards organizations to produce CM guidance documents including ANSI/NIRMA, INPO, NEI, EPRI, and IAEA. *(See comparison matrix at end of CM Source Documents section).*
- **ANSI/NIRMA CM 1.0** was originally issued in 2000 and revised in 2021
- **INPO** produced AP-929 and AP-932
- **NEI** issued the Standard Nuclear Performance Model
- **EPRI** produced TR-1022684 and TR-1019221
- **IAEA** issued Safety Report 65 and TECDOC 1651

The 2011 Disaster

On March 11, 2011, a magnitude 9.0 earthquake struck Japan, triggering a massive tsunami that damaged the Fukushima Daiichi Nuclear Power Plant. The tsunami caused Beyond Design Basis (BDB) flooding caused the emergency power supplies and electrical distribution systems to be inoperable, resulting in an ELAP (Extended Loss of AC Power) in several of the six units on the site. The ELAP led to (1) the loss of core cooling, (2) loss of spent fuel pool cooling capabilities, and (3) a significant challenge to maintaining containment integrity. All DC power was lost early in the event on Units 1 and 2 and after some period of time at the other units. Core damage occurred in three of the units along with a loss of containment integrity resulting in the release of radioactive material to the surrounding environment.

This event created immediate US Nuclear Industry Actions (IERs) the assembly of the NRC Near Term Task Force (NTTF) which resulted in NRC orders to Licensees, to implement. In response to the NRC order, the Nuclear Energy Institute (NEI) developed many implementation guides such as NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide.*

Note: For further details of the Fukushima disaster, industry actions and responses refer to www.cmbg.org, Resources, Papers & Publications.

With the introduction of new builds, the industry will be further challenged to learn from past CM lessons and contribute to a well-performing support infrastructure to plant operations.

CM Source Documents

This section lists some of the codes, standards, and guidelines related to CM.

DOE Standards

Note: Copies available at: https://www.energy.gov/ehss/nuclear-safety/

DOE-STD-1073-2003	"Configuration Management" • Defines objectives of a CM process for DOE nuclear facilities (including activities and operations) • Provides detailed examples and supplementary guidance on methods to achieve those objectives

ANSI Standards

Note: Copies available from ANSI or through your company library.

ANSI/NIRMA CM 1.0-2021	"Configuration Management of Nuclear Facilities"
ANSI/ANS 3.2-1994	"Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants" • Requires implementation of a CM program
ANSI N18.7-1976	"Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants" • Endorsed by Regulatory Guide 1.33 • Addresses all aspects of operational QA controls including maintenance, modifications, temporary modifications, nonconforming items, design outputs
ANSI N45.2.9-1974	"Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants" • Endorsed by Regulatory Guide 1.88
ANSI N45.2.11-1974	"QA Requirements for the Design of Nuclear Power Plants" • Endorsed by Regulatory Guide 1.64 • Outlines the design process

ANSI Standards (continued)

ANSI/ASME NQA-1	“Quality Program Requirements for Nuclear Facilities” • Based on ANSI/ASME N45.2-1977, including N45.2.11 • Describes QA requirements for design control
ANSI/EIA 649	“National Consensus Standard for Configuration Management”

EPRI Documents

Note: Copies available at: https://www.epri.com/

TR-103586-R2 November 2017	“Guidelines for Optimizing the Engineering Change Process for Nuclear Power Plants” • Provides decision criteria to select level of administrative and technical effort for engineering changes
TR-1019221 December 2009	New Nuclear Power Plant Information Handover Guide
TR-1022684 April 2011	Elements of Pre-Operational and Operational Configuration Management for a New Nuclear Facility
1022991 November 2011	Guideline on Configuration Management for Digital Instrumentation and Control Equipment and Systems
3002003126 December 2014	Advanced Nuclear Technology: Data-Centric Configuration Management for Efficiency and Cost Reduction

IAEA Documents

Note: Copies available at: https://www.iaea.org/publications/

Safety Report 65 December 2010	“Application of Configuration Management in Nuclear Power Plants”
TECDOC-1651 December 2010	“Information Technology for Nuclear Power Plant Configuration Management”

INPO Documents

Note: Copies available through INPO Nuclear Network (ID and password required)

INPO 87-006 July 1987	"Report on Configuration Management in the Nuclear Utility Industry"
INPO 05-003 July 2013 SPSD by INPO 12-013	"Performance Objectives and Criteria"
INPO 12-013 Rev 0 Dec 2012	"Performance Objectives and Criteria"
INPO AP-929 Rev 2 Feb 2018	"Configuration Management Process Description"
INPO AP-932 Canceled Nov 2013	New Plant Configuration Management Development and Implementation Process
INPO 09-003 Rev 1 April 2016	"Excellence in the Management of Design and Operating Margins" • Provides guidance for member utilities in identifying, evaluating, prioritizing, and resolving margin concerns
INPO 10-005	Principles for Maintaining an Effective Technical Conscience
INPO 15-011	Principles for Excellence in Integrated Risk Management
INPO 90-009 Rev 3, Nov 2012 Deactivated Feb 2017	"Guidelines for the Conduct of Design Engineering" • Provides guidance to assist companies in managing design engineering support of their nuclear power plants effectively
IER L1 14-20	Integrated Risk – Healthy Technical Conscience

NEI Documents

Note: Copies available through https://nei.org/home/ (ID and password required)

NEI 96-07 Rev 1, Nov 2000	"Guidelines for 50.59 Evaluations" – Revised to incorporate new 50.59 rules implemented in 1999
NEI 97-04 Rev 1, Feb 2001	"Design Basis Program Guidelines" • Discusses genesis of term "design bases" as defined in 10 CFR 50.2 • Clarifies reportability requirements associated with design basis information • Provides additional examples to assist licensees in identifying design basis information (see Reg Guide 1.186) • Update to NUMARC 90-12 "Design Basis Program Guidelines" dated October 1990
NEI 98-03	"Guidelines for Updating Final Safety Analysis Reports"
NEI 08-09	"Cyber Security Plan for Nuclear Power Reactors" • 4.4.1 Configuration Management and Change Control
Efficiency Bulletins	There are many EBs driven by the Delivering the Nuclear Promise (DNP) initiative. For a complete list of the EBs and other resource material, please refer to https://nei.org/home/
NEI/EUCG Task Force Report Rev 4 December 2003	"A Standard Nuclear Performance Model the Process Management Approach" • A model for evaluating performance measures and costs against nuclear power plant processes. Configuration Control is one of the processes addressed
NEI Report	NEI Configuration Control Process Benchmarking Report – August 2001
NEI 00-04 50.69	10 CFR 50.69 SSC Categorization Guideline • Detailed guidance on categorizing structures, systems and components for licensees that choose to adopt 10 CFR 50.69, Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors. • A licensee wishing to implement 10 CFR50.69 makes a submittal to the Director of Nuclear Reactor Regulation, NRC for review and approval. L

NRC Documents

Note: Copies are available at: https://www.nrc.gov/reading-rm.html

Some general background about NRC documents:

Information Notice	Does not convey changes in NRC policy or guidance and does not recommend specific courses of action.
Generic Letter	May represent new NRC positions or include recommendations; however, the licensee can choose other equally effective courses of actions.
IE Bulletin	**I**nspection and **E**nforcement Bulletin similar to generic letters in effect.
NUREG	NRC-issued technical reports on various topics related to the regulation of nuclear energy.
Regulatory Issue Summary (RIS)	Generic communication.
GL 83-28	Required Actions Based on Generic Implications of Salem ATWS Events • Imposed new requirements on equipment classification/vendor interface, among others.
GL 88-18	Plant Record Storage on Optical Disks • Expanded guidance of Reg Guides 1.88 & 1.28 to describe an acceptable method for storing QA documents in optical media per the criteria in Appendix B to 10 CFR 50.
GL 90-03	Relaxation of Staff Position in Generic Letter 83-28 • Acknowledges INPO initiatives on Nuclear Plant Reliability Data System (NPRDS) and Significant Event Evaluation & Information Network (SEE-IN), both managed by INPO.
IE 98-22 June 17, 1998	“Deficiencies Identified During NRC Design Inspections”
NUREG/CR-5147 June 1988	“Fundamental Attributes of a Practical Configuration Management Program for Nuclear Plant Design Control”

NRC Documents (continued)

Reg Guide 1.186	Endorses examples in NEI 97-04, Rev 1 Appendix B as acceptable way to illustrate what is meant by Design Basis Information.
Reg Guide 1.201	"Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants According to Their Safety Significance"
RIS 2000-18	"Guidance on Managing QA Records in Electronic Media" provides additional guidance requested by the nuclear industry on storing and maintaining QA records in electronic media.
Title 10 to Code of Federal Regulations	
10 CFR 50	Part 50, "Domestic Licensing of Production and Utilization Facilities" Some portions of 10 CFR 50 especially pertinent to CM: **50.2** – Definitions **50.54(f)** – Provision that requires licensees to submit responses under oath if requested by the NRC **50.59** – Changes, Tests and Experiments – describes evaluation process for making changes to nuclear plants **50.69 -** Risk informed categorization and treatment of structures, systems, and components for nuclear power reactors **50.71** – Maintenance of Records, making of reports **App. A** – General Design Criteria – 64 criteria in 6 categories – covers everything from QA records to containment design basis **App. B** – Quality Assurance requirements **50.120** - Training and qualification of nuclear power plant personnel
10 CFR 52	Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" Revised regulation for new NPPS Some portions of 10 CFR 52 especially pertinent to CM: **52.1** – Definitions **Subpart A** – Early Site Permits **Subpart B** – Standard Design Certification **Subpart C** – Combined Licenses **Subpart D** – Standard Design Approvals

NRC Documents (continued)

10 CFR 70	Part 70, "Domestic Licensing of Special Nuclear Material (Fuel Cycle Facilities)"
10 CFR 72.48	Changes, tests, and experiments (Independent Storage of Spent Nuclear Fuel)
10 CFR 73.54	"Protection of digital computer and communication systems and networks"

NRC Inspection Procedures relevant to Configuration Management:

- IP 37051 – Verification of As-Builts 10/07
- IP 37055 – Onsite Design Activities 10/07
- IP 37301 – Comparison of As-Built Plant to FSAR Description 11/08
- IP 37550 – Engineering 11/99
- IP 71111.18 – Plant Modifications 10/08
- IP 71111.21 – Component Design Bases Inspection 08/08
- IP 88070 – Permanent Plant Modifications 09/06
- IP 88071 – Configuration Management Programmatic Review 07/06
- IP 88101 – Configuration Control 12/99

NIRMA Documents

Note: Copies available at: https://nirma.org/ (ID and password required)

Position Papers

PP02-1994	"Configuration Management"
PP03-1992	"Implementing CM Enhancement in a Nuclear Facility"
PP04-1994	"Configuration Management Information Systems"

NIRMA Documents (continued)

Technical Guidelines

TG11-2011*	"Authentication of Records and Media"
TG13-1986**	"Records Turnover"
TG14-1992	"Support of Design Basis Information Needs"
TG15-2011*	"Management of Electronic Records"
TG16-2011*	"Software Quality Assurance Documentation and Records"
TG17-1993	"Management of Nuclear Related Training Records"
TG18-2001	"Guideline for Vendor Technical Information Program Implementation"
TG19-1996***	"Configuration Management of Nuclear Facilities" Basis for ANSI/NIRMA CM-1.0-2000 standard on Configuration Management
TG20-1996	"Drawing Management Program Principals and Processes"
TG21-2011*	"Required Records Protection, Disaster Recovery and Business Continuation"
TG22-2001	"Management of Electronic Vendor Technical Documents"

* The 1998 editions of TGs 11, 15, 16, and 21 are those endorsed by NRC RIS2000-18, Quality Assurance Records in Electronic Media

** Reaffirmed 2002

*** This was withdrawn with the issue of ANSI/NIRMA CM 1.0

WANO Documents

Note: Copies available at: https://www.wano.info/

GL-2001-04 June 2002	"Guidelines for Plant Status and Configuration Control at Nuclear Power Plants" • Provides an operations-focused description of SSC status control
GP ATL-09-002 November 2009	NX-1068 – "Margin Management" • Provides a copy of Exelon fleet procedure ER-AA-2007-Rev. 1 – "Margin Management"

	NIRMA/ANSI CM 1.0	INPO AP-929	IAEA Safety Report 65
Applicability	Existing Facilities	Existing Facilities	Primarily Existing Facilities
Terminology	Standardized basic CM terminology across the industry	Similar to NIRMA/ANSI CM 1.0	Limited to terms used in the document
CM Program	Guidance on Program Planning	Addressed as a process	Describes CM Program attributes and how to set up program
Graded Approach	Defined and mentioned, but not described	Defined and mentioned, but not described	Only mentioned in terms of information management
Fundamentals	• Establishes 3-ball model • Addresses Equilibrium Restoration	• Uses 3-ball model • Detailed description of equilibrium restoration • Detailed Explanation of Design Basis • Detailed explanation of Design Margins • Plant Modification Process Description / Flowchart	• Uses 3-ball model • Detailed description of equilibrium restoration • Establishes the 5 Functional Areas of CM • Discusses Human Factors and Knowledge Management (KM)
Information	Provides FCI guidance	Covered in Equilibrium Restoration and Mod process	Called Facility Configuration Documents
Requirements	Described	Covered in Equilibrium Restoration and Mod process	Described in detail
CM Assessments	Discussed	Not addressed	Described in detail
CM PIs & Health Report	Mentions CM PIs & Health Report	Detailed discussion of PIs	Detailed discussion of PIs
CM Awareness & Training	Described in broad terms	Not addressed	Discussed in terms of Human Performance & KM

	EPRI TR-1022648	AP-932
Applicability	New Builds	New Builds
Terminology	Associated with Advanced Technology, i.e., Interoperability, Virtual Plant, XML Schemas, etc. and 10 CFR 52 space, i.e., COLA, DCD, COL, ITAAC, etc.	Minimal definitions
CM Program	Detailed guidance on setting up program	Describes CM program attributes
Graded Approach	Provides detailed process and data-centric graded approach descriptions/examples	Not mentioned
Fundamentals	• Adds Virtual Plant to 3-ball model • Describes CM lifecycle from conception to decommissioning	• Discusses 3D model • Describes data integration and defining data relationships/linkages
Information	Establishes SSC Information Repository and controls	Describes in terms of process flowchart
Requirements	Detailed guidance on identifying and managing requirements	Includes as CM Program Attribute and in process flowchart
CM Assessments	Discussed throughout, but not in a topical area	Not addressed
CM PIs & Health Report	Not addressed in detail	Not addressed
CM Awareness & Training	Described in broad terms	Included as CM Program Attribute

The 5 Functional Areas of a Configuration Management Program

1. **Protect the Design Basis**

   Design Output documents shall conform to Design Requirements. This area is owned by the Design Authority.

2. **Modify the Plant**

   Changes to Physical Configuration shall conform to Design Output documents and Design Output documents shall conform to Design Requirements. This area is owned by the Design Authority.

3. **Operate the Plant**

   Physical Configuration shall conform to Operational Configuration information typically communicated through procedures. Operational Configuration information may not exceed design. This area is owned by the Plant Manager.

4. **Maintain the Plant**

   Physical Configuration must conform to requirements of other Operating, Maintenance, Training, and Procurement Information. This area is owned by the Plant Manager.

5. **Test the Plant**

   Physical Configuration must be shown to conform to existing design requirements. This area is owned by the Plant Manager.

CM Visuals

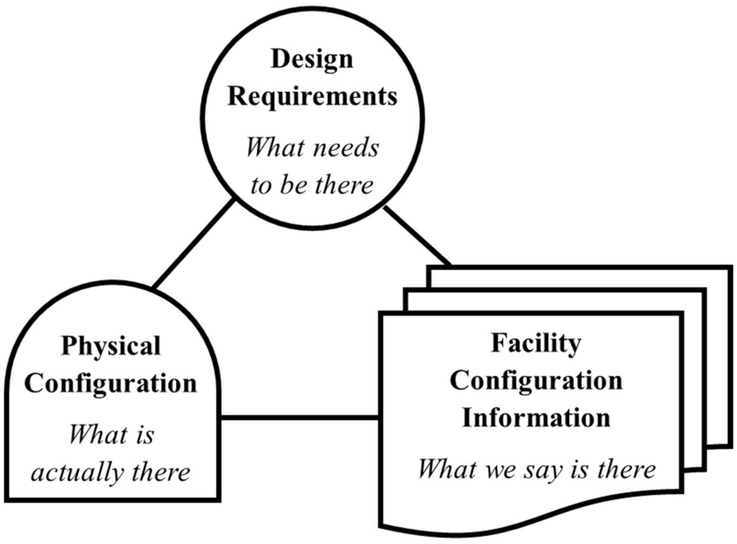


Figure 1: Configuration Management Objective

The “3 Ball” CM Model as represented in guidance documents around the world. It is also known as the “CM Equilibrium”.

The CM Process Model also known as the “CM Equilibrium Restoration” Diagram. A complete explanation of the process is contained in INPO AP-929.

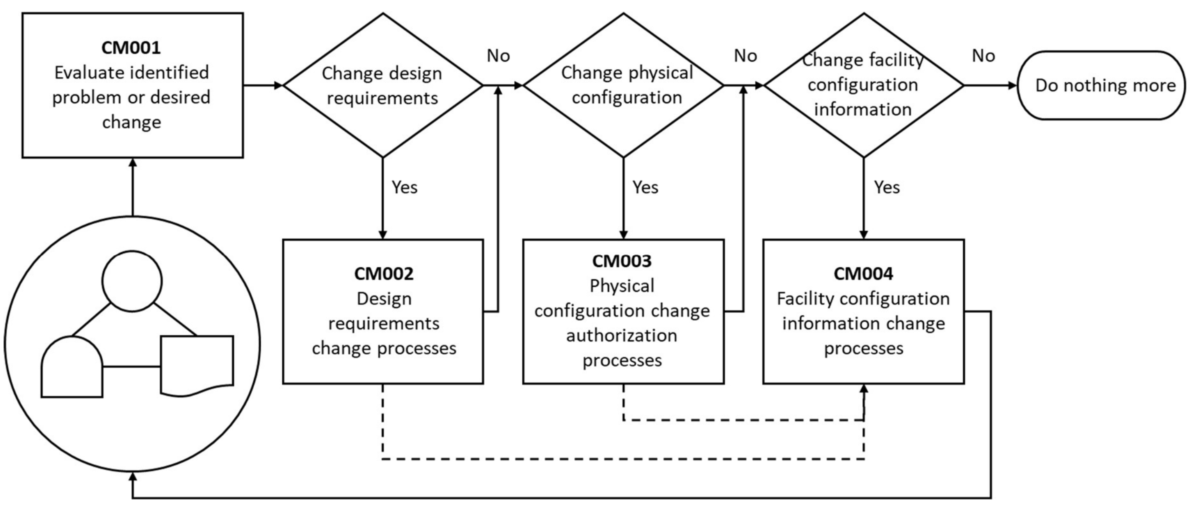


Figure 2: CM Equilibrium

Note: For further detail of CM process activity CM001 through CM004, refer to the AP-929.

CM Life Cycle Diagram

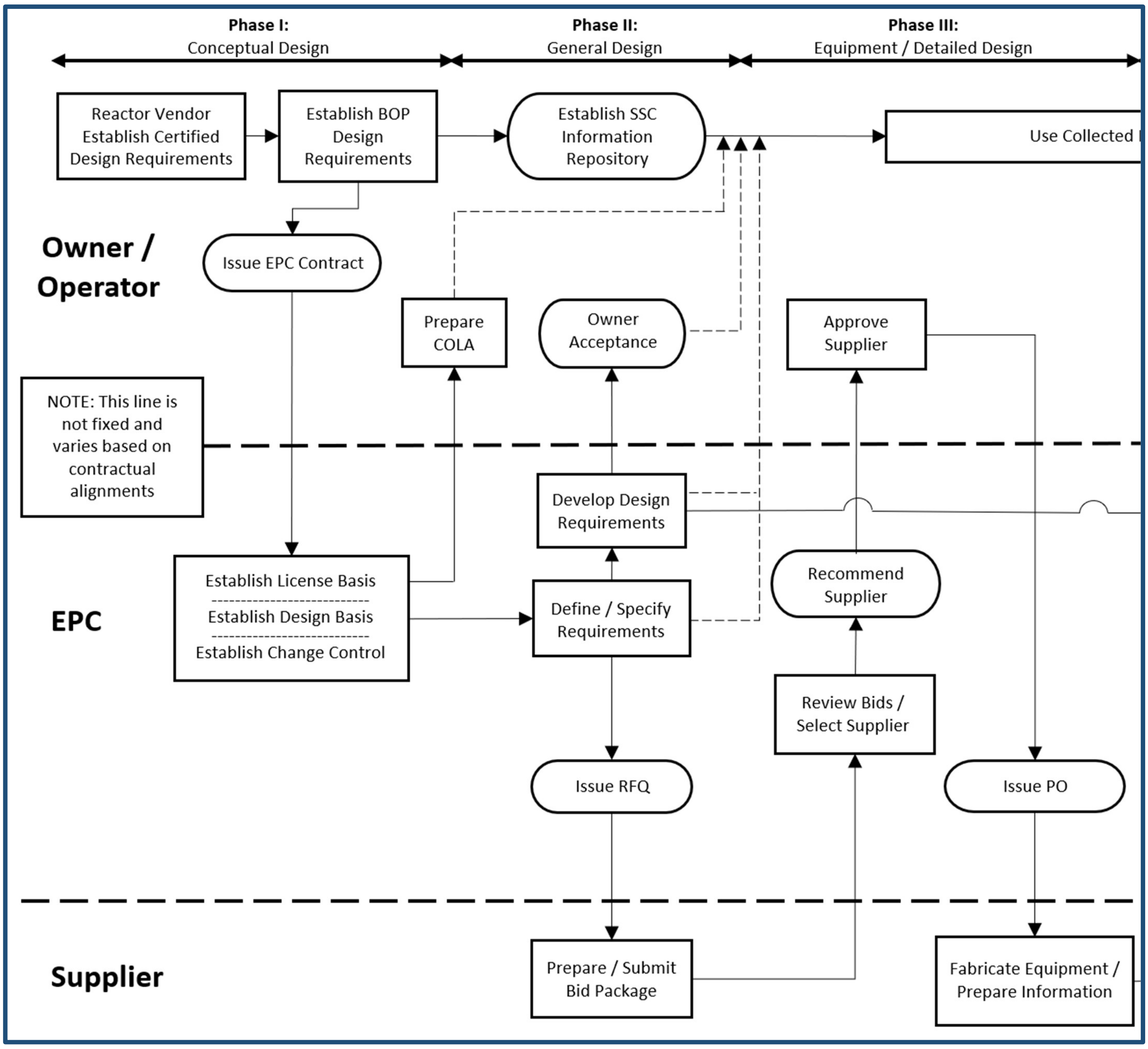


Figure 3: Phase I, II, and III of CM Life Cycle

CM Life Cycle Diagram

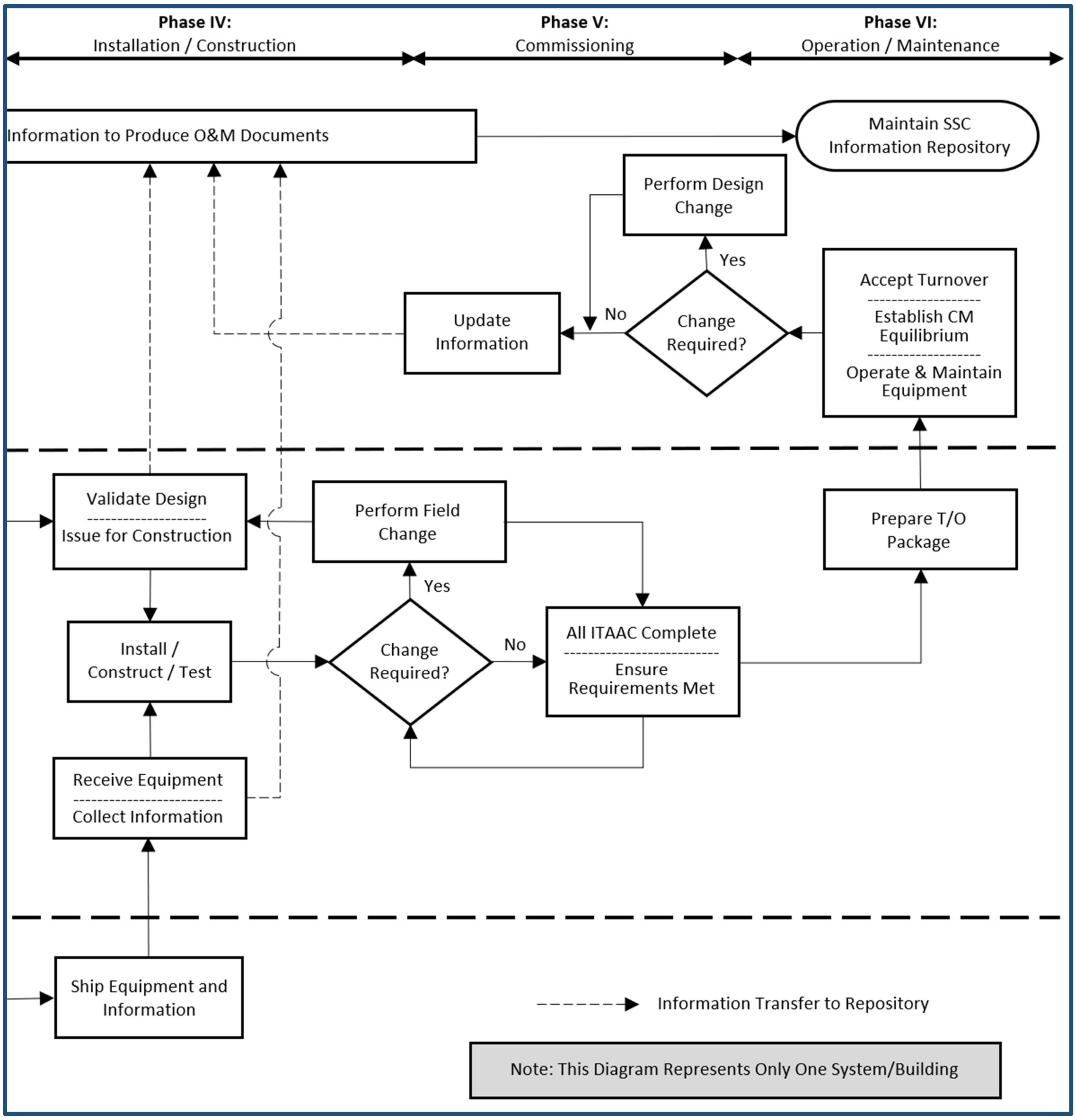


Figure 4: Phase IV, V, and VI of CM Life Cycle

CM Margin Definitions & Visuals

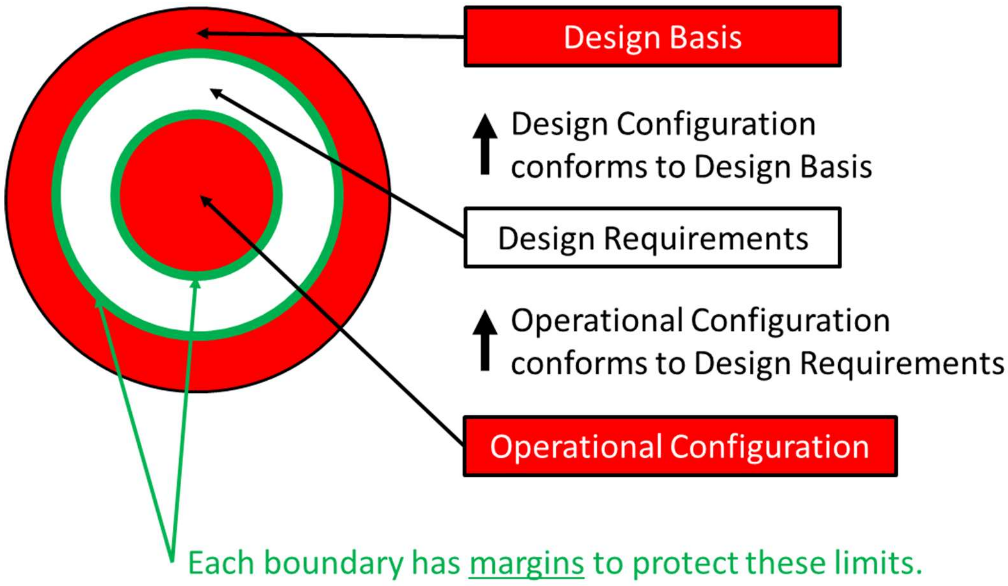


Figure 5: Design Basis, Design Requirements, and Operational Configuration

This diagram is used to illustrate the relationship of design basis to margins. The design basis serves as the bounding conditions and requirements for the design. The engineer develops the design configuration form these requirements and establishes the operational configuration to ensure that the design basis is protected.

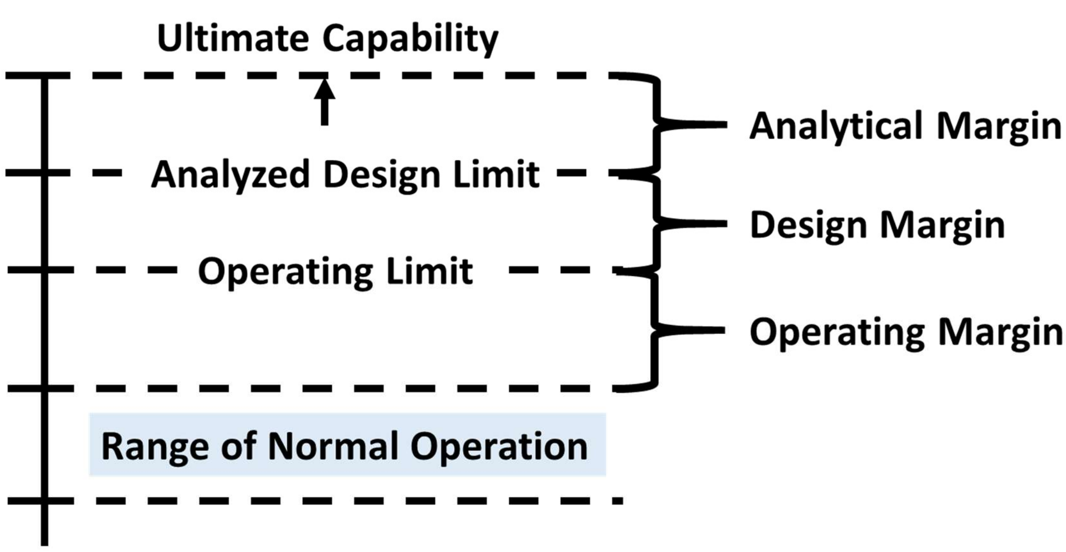


Figure 6: CM Margins

This model shows the various types of margins encountered in a nuclear facility. Definitions related to CM margins are provided on next page.

Analytical Margin – The difference between the analyzed design limit and the ultimate capability or failure limit. This is typically an unanalyzed region that cannot be used unless an analysis is performed to establish a new analyzed design limit. Analytical margin consists of conservative assumptions and methodologies used to account for uncertainties in design, materials, or fabrication. In some cases, an exact value for this margin cannot be specifically determined. Operating in this area does not mean failure is imminent, only that it is not documented in any current design calculations.

Analyzed Design Limit – The limiting condition of a system or component from an engineering perspective. This value is typically found in engineering calculations and includes both Design Margin and Code/Standard/Regulatory Margin. This provides a boundary that describes the analyzed condition.

Code/Standard/Regulatory Limit – The maximum or minimum value imposed by a code/standard or regulator on operation of the SSC for a particular margin parameter.

Code/Standard/Regulatory Margin – A value established by industry code/standard organizations and/or the regulator. The bounds for this margin may be prescribed by a pre-defined safety factor or determined by industry experience. Changes to this margin must be reviewed and approved by the code/standard organization and/or the regulator.

Design Margin – The conservatism identified during the design process that exists between the code/standard or regulatory limit and the operating limit. Design margins may be defined by engineering judgment or by industry code-defined values. The design authority controls this margin. Design margin is assigned by the design engineer to account for the following:

- Design assumptions used in calculations including operator action / response
- Equipment tolerances, such as pipe wall-thickness, structural component dimensions, and electrical relay actuation times
- Instrumentation tolerances
- Calculation roundoff
- Allowance for expected degraded equipment performance

Operating Limit – The maximum or minimum operating value imposed on the operation of the system for a particular parameter involving little or no risk of failure. The limit is normally specified in facility configuration information (procedures, drawings, specifications, and databases) or included in technical specifications. Also known as Normal Operating Range.

Operating Margin – The difference between the extreme of the normal operating range and the operating limit of the system. The Operations Department maintains a range of normal operations. What remains is the operating margin. Degraded equipment, plant modifications or analytical / instrument creep can reduce the operating margin. Administrative controls used to maintain margin may limit the range of normal operation.

Range Of Normal Operations – Parameter range in which the system or component is normally operated. Typically, an alarm or an annunciation is in place that requires operator action if the range of normal operations is exceeded.

Ultimate Capability/Failure – The point at which functional failure would be expected to occur in a system or component. This point is expected to be well above the analyzed design limit, although the exact point of functional failure may be indeterminate.

Facility Configuration Information

Within the nuclear plant, there are different kinds of information. For the purposes of this discussion, this information will be divided into Facility Configuration Information (FCI) and "not-FCI". Examples of information considered "not-FCI" are budget and financial data, personnel and training information, manpower/scheduling information, timekeeping records, and any other information that does not tie directly into plant systems, structures, and components (SSCs) or their relationships.

As shown in the following figure, FCI is further subdivided into unmanaged information, managed for business reasons, and CM controlled.

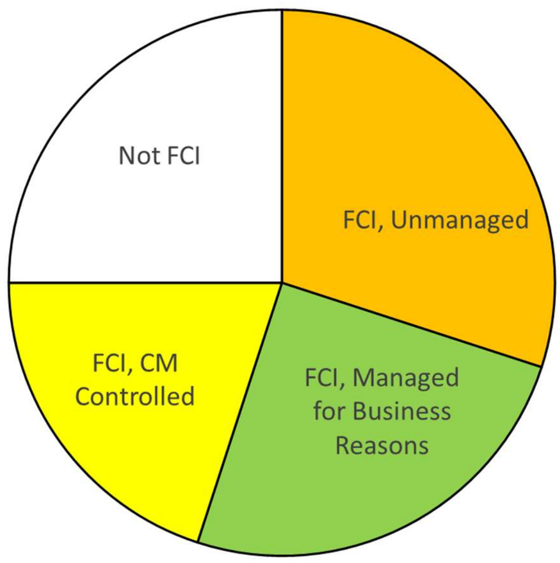


Figure 7: Plant Information Model

Facility Configuration Information is defined as recorded information that describes, specifies, reports, certifies, or provides data or results regarding the design basis requirements or pertains to other information attributes associated with the facility and its structures, systems, and components (SSCs).

FCI may be contained in original hard media (Mylar, etc.), paper copies, electronic media and any other sources of information used to make sound technical decisions regarding authorization/licensing, design, construction, procurement, modification, operation, maintenance and decommissioning of the facility. It also includes current information, pending information and records (historical information).

Facility Configuration Information

Examples of facility configuration information (FCI) are:

FCI Unmanaged

- Field sketches
- "Back-of-the-envelope" calculations to resolve emergent problems
- Temporary equipment readings
- Insignificant database fields regarding plant equipment
- Information not necessary for retention

FCI, Managed for Business Reasons

- Documents related to plant insurance coverage
- Plant availability/reliability statistics
- Turbine performance test procedures and results
- Portions of equipment operating and maintenance procedures not related to design/license basis requirements
- Receipt inspection results
- Equipment-related personnel safety issues

FCI CM Controlled

- Documents that demonstrate compliance to design/license basis requirements, such as selected portions of equipment operating and maintenance procedures, valve/system lineup checklists, etc.
- Tech Spec surveillance procedures and results
- ISI NDE and Pump & Valve operability test documentation
- Plant equipment chemistry configuration
- Design calculations, drawings, specifications, etc.
- Engineering change process documentation, such as Plant Modifications, Equivalency Evaluations, Design Document Change Packages
- Vendor Technical Manuals

Facility Configuration Information

Most of the decisions regarding the operation, maintenance and modification of the facility are made on the basis of FCI which describes the physical or logical plant design, its design and actual parameters, or its design/license bases. This reliance on such information is necessary because the design and license requirements generally cannot be determined by simple observation of the physical configuration and because access to the physical configuration is sometimes difficult or not possible, time-consuming, expensive, and may cause additional radiation exposure.

The quality of the decisions made depends directly on the quality of the information available. Much of the facility configuration information currently available was initially collected during plant construction but was not walked down or otherwise verified prior to Operations turnover. The plant owner company decides to keep this unverified information, including drawings and data, and verify it as needed while doing work.

Due to the volume and redundancy of facility configuration information and the amount of change to the physical plant and associated information, constant attention to detail and an overall questioning attitude are required when using such information, particularly to do work that may have an impact on nuclear safety. In cases where safety may be impacted by the result of a process, it is expected that workers will also have a questioning attitude about information that is used as an input to the process, regardless of whether it is believed to have been verified in the past or not. It is also expected that workers will correct, or identify for correction, errors in such information when found.

When changes are being made to the physical configuration that prompt information updates, it is important to ensure that all information sources affected by a change are updated in a timely manner applying a graded approach.

CM Relationships

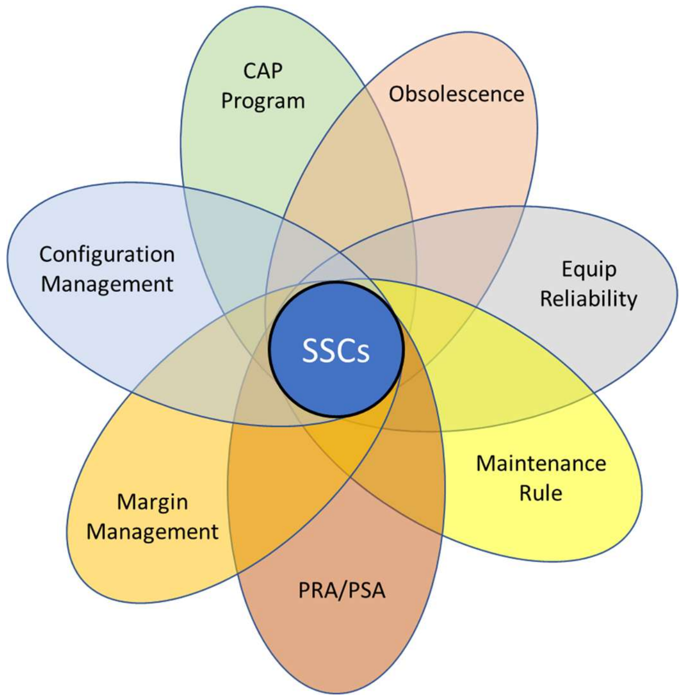


Figure 8: CM Relationships

At nuclear facilities, several initiatives have come on the scene in recent years that appear to have overlapping or redundant objectives and focus. The common denominator for these initiatives is the plant structures, systems, and components (SSCs). To explain their relationships:

Obsolescence has become an issue because of manufacturers leaving the nuclear industry or no longer producing or supporting their products. CM is impacted by the necessity to understand and define the requirements of the SCCs to maintain equivalency and to keep the FCI consistent with the replacement items. Sometimes an "equal-to-or-better-than" evaluation can determine that an acceptable substitute exists for the obsolete SSC; however, if the functionality is affected, a formal modification is required.

CM Relationships

The **Maintenance Rule**, governed by 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants” includes the need to assess the ongoing maintenance activities for risk significant SSCs. One aspect of the Maintenance Rule is maintaining the Equipment Out-of-Service (EOOS) log. The EOOS is a Probabilistic Safety Assessment (PSA)-based quantitative evaluation of plant risks for various SSC configurations in plant modes 1 through 3. The CM impact is that identified out-of-service equipment should still be maintained within the design parameters. Maintenance must recognize when the configuration equilibrium is upset and involve Engineering to restore it accordingly.

Integrated Equipment Reliability (i-ERIP), driven by the NEI Nuclear Standard Performance Model and INPO AP-913, “Equipment Reliability Process Description” establishes a risk-based decision process for monitoring SSC performance. The information is used for short-term work planning and long-term planning to proactively identify and resolve equipment health risk issues. i-ERIP promotes intolerance for unexpected failures in critical equipment. Critical equipment is identified by PSA performing a Functional Importance Determination (FID).

Probabilistic Risk Analysis and Probabilistic Safety Assessment (PRA/PSA) software programs determine the consequences of SSC failures on plant operability. It should be noted that the PRA/PSA is a tool to evaluate risk/safety significance and is useful to consider in making decisions regarding plant operation. However, while it models the design and operation of the plant and is required by the Maintenance Rule (10 CFR 50.65) program, it is not intended to constitute a design or licensing basis analysis. An item defined as low risk significant by the PRA/PSA might represent a significant regulatory issue. The CM impact is that these analyses must rely on current configuration information that matches the physical configuration to provide accurate information to the other programs.

CM Relationships

The facility's **Corrective Action Program (CAP)** should be used to identify SSC failures so that the cause(s) can be determined, and potential trends identified. Action plans to correct the problem and prevent future recurrences are also tracked in the CAP. SSC priorities in CAP are established by the FID performed for the i-ERIP. CM is integrally linked to the CAP. Many of the CM Program performance indicators come from CAP results.

Margin Management, as explained in INPO Good Practice 09-003, is conservatisms incorporated into system design and operational limits – the design and operating margins – to ensure that operators and plant systems have sufficient flexibility to accommodate routine activities and the capability to respond to anticipated transients and accident scenarios effectively. Careful configuration control, evaluation of changes, and monitoring of equipment degradation are necessary to maintain acceptable levels of design and operating margins. In addition, when margins are low, personnel should fully evaluate the risk, evaluate degradation mechanisms, and establish compensatory actions to mitigate the loss of margin until sufficient margin is established.

Configuration Management (CM) as described in ANSI/NIRMA CM 1.0-2021 is the program that assures that the facility design requirements match the physical configuration and the facility configuration information. Although CM is integrated with most facility processes, its primary focus is on SSCs. As with the other programs described above, CM is applied in a graded manner with greater emphasis placed on high-risk, high-value SSCs.

Applying a Graded Approach

Because of practicality and cost, full CM controls might not be uniformly applied to all SSCs and FCI within the facility. The CM program is established to allow a graded approach to different elements such as the following:

1. Which SSCs/FCI are in the program
2. SSC/FCI classifications and attributes
3. The processes governing CM activities
4. A combination of the preceding elements
5. The degree of controls applied to the elements

For SSCs, the graded approach is based on an assessment of the relative importance of an SSC and/or SSC attributes to nuclear safety and economic factors, taking the following into consideration:

- The requirements of applicable regulations, codes, and standards
- The complexity or uniqueness of the item or activity and the environment in which it must perform
- The quality history of the item
- The degree to which functional compliance can be demonstrated or assessed by testing
- The anticipated life span of the item
- The consequences of failure

For FCI, the graded approach is based on a data-centric approach. The table on the next page provides an example of the grading approach for FCI relative to the SSC with which it is associated.

Industry documents such as NUREG-1397, INPO AP-929, EPRI TR-1008254 and NIRMA TG20-1996 uses the terminology of “priority” or “level” for classifying a graded approach. Both terminologies are acceptable depending on Utility software functionality.

Data-Centric Application of CM Graded Approach

Activity	Design and Licensing Basis SSCs	High-Value SSCs	All Other SSCs
Data generation and revision	Applies	Applies	Applies
Data categorization required	Applies	Applies	Applies
Data review and verification required	Applies	Applies as defined by procedure	Does not apply
Define update frequency required	Applies	Applies as defined by procedure	Applies as defined by procedure
Data approval required	Applies	Applies as defined by procedure	Applies as defined by procedure
Data input independent verification required	Applies	Applies	Does not apply

For processes, the graded approach can be applied based on the influence the process or procedure has on the CM activities. For example, the modification process can be applied differently if the SSC involved is nuclear related versus controlled by commercial practices. Similarly, drawings can be categorized such that their update frequency is based on their importance to operations and maintenance. Applications of process graded approaches are implemented by procedure controls.

The table on the next page provides a matrix showing an example of how CM grading of processes relative to SSCs can be applied.

Data-Centric Application of CM Graded Approach

Activity	Design and Licensing Basis SSCs	High-Value SSCs	All Other SSCs
Define SSC Boundaries	Applies	Applies	Applies
Requirements Change Control	Applies	Applies	Applies as defined by procedure
Equipment Database Control	Applies	Applies	Applies as defined by procedure
Drawing Control	Applies	Applies	Applies as defined by procedure
Calculation Control	Applies	Applies	Applies as defined by procedure
Design Verification and Tech Review	Applies	Applies as defined by procedure	Does not apply
Plant Programs (such as margin management, ER, ISI, and IST)	Applies	Applies as defined by procedure	Does not apply
Modifications	Applies	Applies	Applies as defined by procedure
Field Change Requests	Applies	Applies	Applies as defined by procedure
Equivalency Evaluations	Applies	Applies	Applies as defined by procedure
Setpoint Changes	Applies	Applies	Applies as defined by procedure
Engineering Software Changes	Applies	Applies as defined by procedure	Does not apply
Post Maintenance Testing	Applies	Applies	Applies
Parts Level Controls	Applies	Applies as defined by procedure	Applies as defined by procedure
CM Training	Applies	Applies	Does not apply

CMBG Survival Guide

Acronyms and Abbreviations

Acronym / Abbr.	Description
AE or A/E	Architect Engineer
AECL	Atomic Energy of Canada Limited
ALARA	As Low As Reasonably Achievable
AMP	Aging Management Program
ANSI	American National Standards Institute
AFI	Area for Improvement
ASME	American Society of Mechanical Engineers
BDB	Beyond Design Basis
BDBEE	Beyond Desing Basis External Event
BWR	Boiling Water Reactor
CADD	Computer Aided Drafting & Design
CDA	Critical Digital Asset
CDBI	Component Design Basis Inspection (NRC)
CLB	Current Licensing Basis
CM	Configuration Management
CMBG	Configuration Management Benchmarking Group
COL	Combined Operating and Construction License
COLA	COL Application
CDC	Critical Design Characteristic
DBD	Design Basis Document
DCD	Design Control Documents
DCP	Design Change Package
DNP	Delivering the Nuclear Promise
DOC	Document Only Change
DOE	Department of Energy
EAM	Enterprise Asset Management
EDB	Equipment Data Base
EDSFI	Electrical Distribution System Functional Inspection
ELAP	Extended Loss of AC Power
EOC	Engineer of Choice
EOP	Emergency Operating Procedure
EPC	Engineering, Procurement and Construction
EPIX	Equipment Performance and Information Exchange System (INPO)
EPRI	Electric Power Research Institute
FAT	Factory Acceptance Test
FCI	Facility Configuration Information

Acronym / Abbr.	Description
FLEX	Diverse and Flexible Coping Strategies
GL	Generic Letter
IAEA	International Atomic Energy Agency
IE	(NRC Office of) Inspection and Enforcement
IEE	Item Equivalency Evaluation
INPO	Institute of Nuclear Power Operations
INUOG	International Nuclear Utility Obsolescence Group
ISFSI	Independent Spent Fuel Storage Installation
ITAAC	Inspections, Tests and Acceptance Criteria
MEL	Master Equipment List
NDE	Non-Destructive Examination
NEA	Nuclear Energy Agency
NEI	Nuclear Energy Institute
NEIL	Nuclear Electric Insurance Limited
NERC	North American Electric Reliability Corporation
NIRMA	Nuclear Information and Records Management Association
NIMSL	Nuclear Information Management Strategic Leadership
NITSL	Nuclear Information Technology Strategic Leadership
NNP	New Nuclear Plant
NNPP	New Nuclear Power Plant
NPROS	Nuclear Plant Reliability Data System (INPO)
NSSS	Nuclear Steam System Supplier
NQA-1	ASME QA Requirements for Nuclear Facilities
NRC	Nuclear Regulatory Commission
NRR	(NRC Office of) Nuclear Reactor Regulations
NSIAC	Nuclear Strategic Issues Advisory Committee made up of Chief Operating Officers representing domestic utilities
NUOG	Nuclear Utility Obsolescence Group
NUREG	NRC Staff Technical Reports
NUSMG	Nuclear Utility Software Management Group
OAR	Owners Acceptance Review
OEM	Original Equipment Manufacturer
OBS	Obsolescence
O&M	Operations and Maintenance
PCHG	Permanent Change
PI	Performance Indicator
PRA/PSA	Probabilistic Risk Analysis or Assessment/Probabilistic Safety Assessment

Acronym / Abbr.	Description
PWR	Pressurized Water Reactor
SAMG	Severe Accident Management Guideline
SBO	Station Blackout
SER	NRC Safety Evaluation Reports
SIEP	Standard Item Equivalency Process
SAT	Site Acceptance Test
SDP	Standard Design Process
SMR	Small Modular Reactor *(See Note)*
SNPM	Standard Nuclear Performance Model (see NEI documents section)
SQA	Software Quality Assurance
SSC	Structures, Systems and Components
SSFI	Safety System Functional Inspection
SPV	Single Point Vulnerability
SWOPI	Service Water Operational Performance Inspection
TCHG	Temporary Change
TMOD	Temporary Modification
TSTF	Technical Specification Task Force
VETIP	Vendor Equipment Technical Information Program (see GL 83-28)
VTM/VTD	Vendor Technical Manual/Document
WANO	World Association of Nuclear Operators
XML	Extensible Markup Language

Note: As of July 2025, there are 127 different SMR designs around the world. For further details of the SMRs status and Acronym Types refer to the NEA Small Modular Reactor Dashboard

CMBG Mission Statement

To provide a forum for the exchange of information which is useful to practitioners of nuclear facility configuration management and to act as the CM Community of Practice for the nuclear industry.

CMBG Steering Committee

(as of May 2026)

Andrew Neal, Chair	Southern Company
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Roger Andreasen	Ameren
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Benefits of a Data-Centric Configuration Management System

The Progressive Benefits of moving to a Data Centric Configuration Management System for Operating Plants and New Builds (Reference EPRI 3002003126)

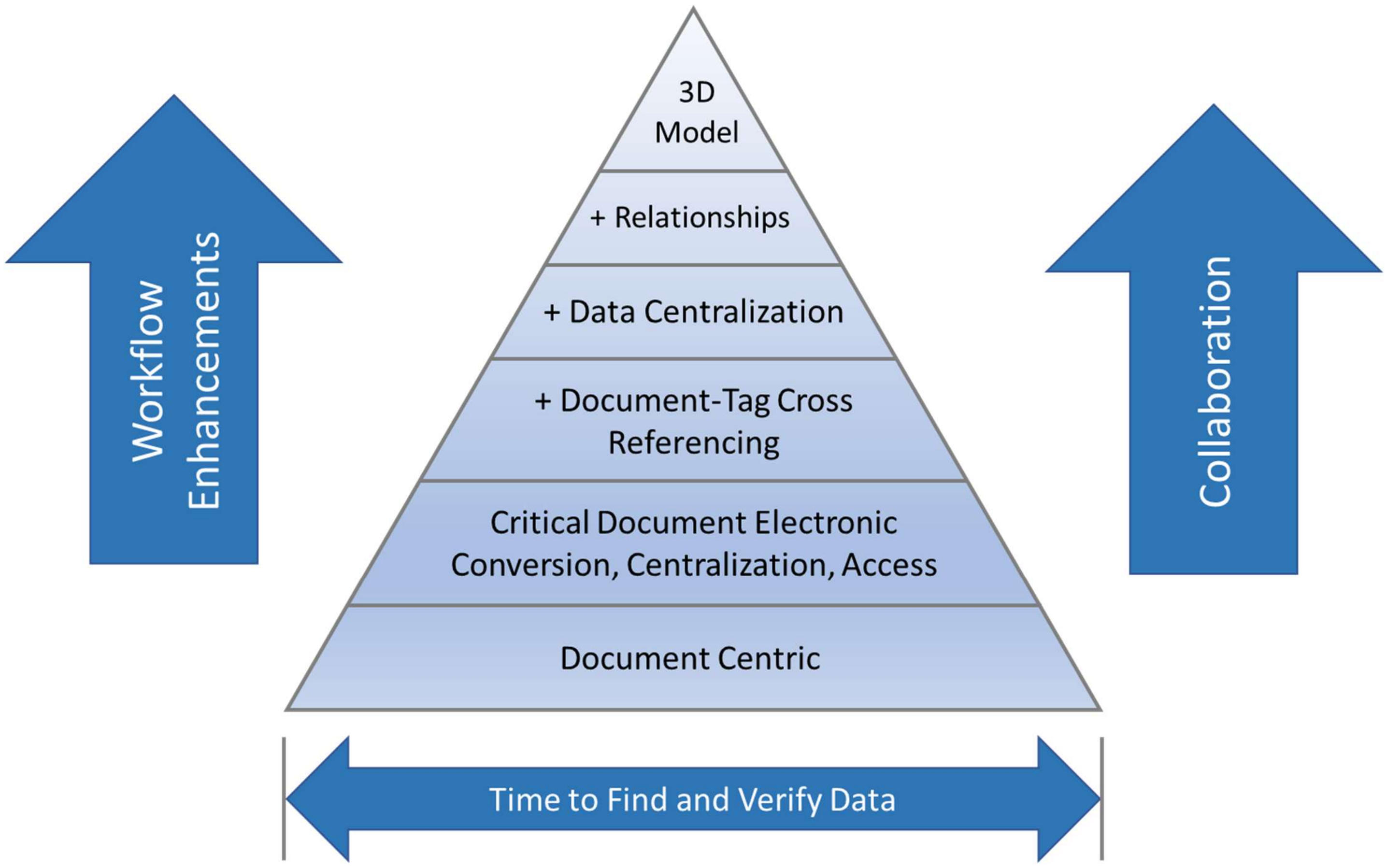

Figure 9: Data-Centric CM End States

The EPRI Study defined five end states toward achieving a "Data-Centric CM System" in a logical order of implementation that provides the most benefit for the investment. These end states apply equally for an operating plant as well as a new build. The difference is the additional investment an operating plant will have to invest in electronic conversion and indexing of documents, mining critical data in documents, and establishing relationships and cross references. Implementing these end states with a rigorous change control process should progressively reduce the amount of time an engineer spends finding the data centric "answer" and validating its accuracy.

Benefits of a Data-Centric Configuration Management System

End State	End Goal
1-Electronic Document Centralization	All routinely used documents and records are in electronic, text searchable format. All documents and records, regardless of medium, are indexed in a Master Document List.
2-Document-Tag Cross Referencing	The Master Equipment List is expanded to include other data objects such as critical cables, weld numbers, piping components, and electrical devices managed in engineering programs. The MEL tag numbers are cross referenced to critical supporting documentation.
3- Data Centralization	Siloed databases that manage configuration data are eliminated and centralized in the single source of truth. The properties describing different tag objects are expanded to include the additional properties needed to support the engineering programs. Note: there may still be a need to buy a specialized program to manage an engineering program; the goal is to centralize the data in the single source of truth and interface the data with the specialized program to minimize change control of multiple databases.
4-Object-Relationship Model	End States 1-3 can be achieved with existing databases such as Maximo or Asset Suite. An object-relationship model in most cases will require a significant software upgrade. An object relationship model has infinite dimensions for making relationships. This relationship “chain” can greatly improve the ability to define the impact of a plant change on support documents and data.
5- Integration with the 2D/3D Model	End State 5 is primarily for operating plants that were designed with 2D and 3D models. The utility should consider maintaining these models after they go operational and using the model as a user interface to the underlying data for the tagged objects in the model. Some operating plants have created laser scanned models of portions of the plant, e.g., inside containment. These models can be “hot spotted” with tag labels that can be linked to the underlying data model.

Benefits of a Data-Centric Configuration Management System

The EPRI study provides a detailed Probabilistic Return on Investment (ROI) model that any plant owner can use to analyze the expected payback period based on the plant's assumptions on cost of implementation versus expected returns. In addition to the benefits of data centricity that reduces the time to find and validate the data centric "answer", the ROI model also considers the added workflow efficiencies from the implementation of electronic workflow (with electronic signatures) and electronic team collaboration.

Delivering the Nuclear Promise

Companies that operate America's nuclear plants have partnered on a multiyear strategy to transform the industry through efficiency improvements impacting CM. Efficiency Bulletins (EBs) are published to address ways to increase efficiencies. One of the EBs impacting CM is EB 17-06, Implement Standard Design Change Process.

Implement the Standard Design Change Process – NEI Efficiency Bulletin 17-06

Standard Design Process (SDP) – An initiative issued to Nuclear Utilities per the Nuclear Energy Institute (NEI) March 6, 2017, Efficiency Bulletin (EB) 17-06 Implement Standard Design Change Process. The most current EB is Revision 3 January 22, 2021. Revision 3 provided reference to NISP-EN-04 developed by EPRI in collaboration with industry subject matter experts and provides detailed guidance while used is conjunction with IP-ENG-001 for developing digital engineering change packages. The SDP is governed by industry procedure IP-ENG-001 and NISP-EN-04 endorsed by the Nuclear Strategic Issues Advisory Committee (NSIAC) who determined that implementation of the SDP to be mandatory within the domestic utilities. Maintenance and update for the SDP procedure is coordinated through the Design Oversight Working Group (DOWG) with final change authority coordinated through the domestic industry Engineering Vice President Peer group.

Implement the Standard Item Equivalency Process – NEI Efficiency Opportunity 18-EG-01

Standard Item Equivalency Process (SIEP) - An initiative issued to Nuclear Utilities per the Nuclear Energy Institute (NEI) October 5, 2018, Efficiency Opportunity (EO) 18-EG-01, This efficiency opportunity improves quality and timely disposition of alternate replacement items necessary to address issues such as obsolescence through application of a best practice industry standard, that efficiently evaluates alternate replacement items. The SIEP is governed by industry procedure NISP-EN-02, Standard Item Equivalency Process.

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CMBG Survival Guide

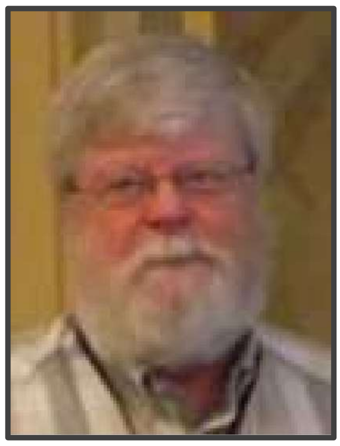
"Buzzword Bible"

This section defines some of the shortcut jargon you'll hear at a CM Conference. Most of the codes and standards are described in the "Source Documents" section.

Word	Description
50.54(f)	Section of 10 CFR 50 which allows NRC to request information under oath; CM reference to letter issued in November 1996 asking utilities how design basis information was controlled and maintained.
50.59	"Changes, tests and experiments" outlines NRC policy for valuating changes to plant design or operating procedures
88-18	NRC Generic Letter 88-18: "Plant Record Storage on Optical Disks"
97-02	INPO 97-02 "Performance Criteria and Guidelines"
97-04	NEI 97-04 "Design Basis Program Guidelines"
98-22	NRC Information Notice IE 98-22 "Deficiencies Identified in…"
Appendix A	10 CFR 50 Appendix A (see under NRC documents)
Appendix B	10 CFR 50 Appendix B (see under NRC documents)
CM Equilibrium	A state that represents conformance of the three CM Elements: design requirements, physical configuration, and facility configuration information. In this state, the SSCs are performing as expected, personnel are being trained, procedures are in place and being followed, and the CM program is being monitored and results trended.
Digital CM	Digital configuration management includes software CM, as well as CM principles applied to hardware, data, user parameters, documents, tools (hardware + software) and other configuration items important for safe, reliable operation and maintenance of digital systems and components.
FCI	Recorded information that describes, specifies, reports, certifies, provides data or results regarding the design/design basis requirements or that pertains to other information attributes associated with the facility and its SSCs.

“Buzzword Bible”

Graded Approach	Because of practicality and cost, full CM controls might not be uniformly applied to all SSCs and FCI within the plant. For SSCs, the graded approach is based on an assessment of the relative importance of an SSC and/or SSC attributes to nuclear safety and economic factors. For FCI, the graded approach is based on a data-centric or document-centric approach.
Virtual Plant	A computer-based information model environment formed by computer technology consisting of 2D and 3D (dimensional), 4D (time), 5D (cost), 6D (material) modeling technology along with data, databases, and electronic document sources
NQA-1	ASME “QA Requirements for Nuclear Facility Applications”
N18.7	ANSI N18.7 “Administrative Controls for Operational Phase …”
N45.2.9	ANSI N45.2.9 “Requirements for… QA Records …”
N45.2.11	ANSI N45.2.11 “Quality Assurance Requirements…for Design”
TG-xx	NIRMA Technical Guides
Taxonomy	A systematic arrangement of objects or concepts showing the relationships between them, especially one displaying a hierarchical arrangement of types.
Temp Mod	A term applied to temporary configuration changes to a nuclear facility. They may be performed as maintenance support, pre-engineered features, procedure-controlled activities, or formal design control activities.



In memory of Lloyd Hancock

9/12/1947 – 3/12/2013

The CMBG Survival Guide was originally developed by Lloyd to assist all who are Nuclear CM practitioners. Lloyd was a wonderful person, a trusted associate, and a major contributor to the CMBG organization. He will be greatly missed.

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