ASME
SETTING THE STANDARD
STANDARDS & CERTIFICATION

Two Park Avenue
New York, NY
10016-5990 U.S.A.

tel 1.212.591.8500
fax 1.212.591.8501
www.asme.org

August 12, 2019

Mr. Brian Thomas, Director
Division of Engineering
Office of Research
Mail Stop T10-A36
Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: ASME Plant System Design Standard

Dear Mr. Thomas,

ASME has chartered a new standards committee to develop a Plant Systems Design (PSD) standard under the Board on Nuclear Codes and Standards. ASME's intent to propose a new standard was presented by Ralph Hill during the February 20, 2019 NRC-ASME Management meeting. At that time, ASME had not officially approved formation of a standards committee to develop the standard. I am now pleased to report that the Plant Systems Design Standards Committee and its subcommittees have been approved and have been meeting since May 2019 Code Week.

Mr. Ralph Hill has been selected to Chair this new standards committee and lead this effort.

During the February 20, 2019 NRC-ASME Management meeting, Ralph Hill agreed to furnish a description of the vision for the new standard and the desired level of NRC interaction. This letter is in response to that action item.

Attached is a presentation that describes the vision and objectives of the new standard and the organization of the Plant Systems Design Standards Committee and its subcommittees. A Special Working Group on Regulatory Endorsement has also been established.

The presentation also shows the planned path forward. The current focus is on developing roadmaps and flowcharts of what needs to be covered in each of the major sections of the standard. In short, this is the plan for characterizing the content. Once the content is characterized, the committee will begin the writing process.

Currently, the committee plans to convene face-to-face meetings twice per year; one of those in conjunction with ASME Boiler Code Week. Most of the work by the committees will be accomplished using remote conferencing tools. Some of the subcommittees are meeting remotely every two weeks. Meetings are generally limited to 1.5 hours. The next face-to-face meeting will be in Atlanta, GA, in conjunction with ASME Boiler Code Week. Dates are October 27 (full day) and 28 (morning only).

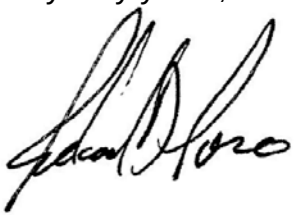
The PSD standard will be technology neutral, addressing design of plants with significant safety hazards to worker and public safety. However, the initial focus is on nuclear. Please see the charter in the attachment. We have a wide-range of industry participation. To provide you with a perspective on industry participation, I have attached the current roster.

In the included roster you will note that we have had significant participation from the NRC. Kamal Manoly is a Member of the Plant Systems Design Standards Committee, Phan Hahn and Ching Ng Ashley are members of the Subcommittees on HAPRA, Probabilistic Design Methods, and Systems Engineering Design Integration, respectively. Currently, this level of participation meets the desired level of NRC interaction.

We thank you for the support the NRC has been providing and look forward to continued participation by the NRC on the Plant Systems Design committees.

If you have any questions in regards to the contents of this letter, please direct them to Mr. Christian Sanna, Director, ASME Nuclear Codes & Standards by telephone (212) 591-8513 or by e-mail SannaC@asme.org.

Very truly yours,



Richard D. Porco
Chair, ASME Board on Nuclear Codes and Standards

Enclosures:

1. ASME System Design Standard Presentation
2. ASME Plant Systems Design Roster

cc: Officers, ASME Board on Nuclear Codes and Standards
Officers, ASME Committee on Plant System Design

ASME Plant Systems Design Standard

NRC/ASME Management Meeting

Teleconference
August 14, 2019

Ralph Hill
Chair, Plant Systems Design Standards Committee
hillr@asme.org

the Problem

At Context Level

New nuclear plants may not be built in the United States unless costs to license, design and construct can be significantly reduced, while ensuring safety of the worker and the public.

At Project Level

New nuclear plants may not be built in the United States unless design and construction costs can be significantly reduced, while ensuring safety of the worker and public.

the Solution

A technology neutral standard that provides a framework, including requirements and guidance, for design organizations to:

- conduct plant process hazard analysis in early stages of advanced plant technology design that (a) advance as the design matures and (b) provide structure to the initial development of a probabilistic risk assessment
- incorporate aerospace "Systems Engineering" design processes, practices and tools with traditional architect engineering design processes, practices and tools
- incorporate risk informed probabilistic design methodologies with traditional deterministic design methods using reliability and availability targets

... and integrate them into their existing design processes and procedures.

Systems Engineering

… a transdisciplinary and integrative approach, to enable the successful realization, use, and retirement of engineered systems, using systems principles and concepts, and scientific, technological, and management methods. (www.incose.org)

the Objectives (1 of 2)

1. **Safer** and **more efficient** system designs and design alternatives with **quantified safety levels**
2. **More effective requirements management**
   - including assumptions, TBDs and TBVs
3. More **cost-effective** and **timely** strategies for issue resolution and design maturation
   - e.g., alternatives analysis, design modifications, earlier formulation of safety function design criteria, additional research, laboratory testing, and scale testing

the Objectives (2 of 2)

4. **Combine risk informed probabilistic design** methodologies **with traditional deterministic design** methods using reliability and availability targets developed by JCNRM in accordance with a companion standard for Establishing Plant System & Component Reliability Targets.
5. Cover design of facility plant systems over the **entire life cycle** of a plant (design, construction, operation, decontamination and decommissioning)
6. Be **system based**, vs. component based, and cover multiple disciplines (mechanical, electrical, instrumentation & control, HVAC, etc.)

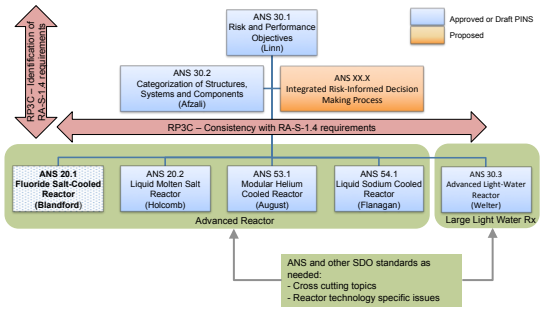
Related Initiatives

The following are ongoing and include similar objectives.

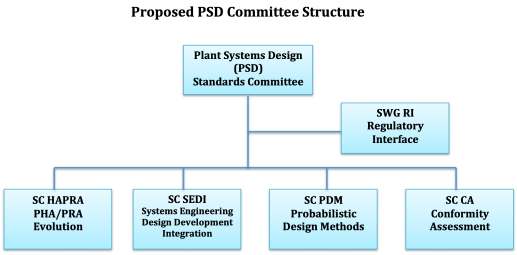
- ANS & ANS 30.1
- EPRI Body of Knowledge (BoK)
- 2025 Nuclear Construction Code
- BPTCS TG Risk-Based Design
- Section XI, Div. 2, Requirements for Reliability and Integrity Management Programs for Nuclear Power Plants (RIM)

See next slide and Background Slides for more detail

ANS New Reactor RIPB Standards Structure



Plant Systems Design Organization



PSD Standards Committee Charter

(as approved by BNCS) (proposed 6/18, Record 19-1863, BNCS Ballot 19-2191)

To develop, review and maintain a technology neutral standard for design of plant systems for nuclear, fossil and petrochemical, chemical, and hazardous waste plants and facilities. The standard provides processes and procedures for design organizations to: (a) integrate process hazard analysis in the early stages of design; (b) incorporate and integrate existing systems engineering design processes, practices and tools with traditional architect engineering design processes, practices and tools; and (c) to integrate risk informed probabilistic design methodologies with traditional deterministic design. The focus is to provide requirements and guidance for design processes, methodologies and tools that will provide safer and more efficient system and component designs with quantified safety levels.

Charter: PSD Subcommittee on PHA & PRA Evolution (SC HAPRA)

To develop, review and maintain technology neutral processes and procedures for design organizations to conduct **process hazard analysis** for nuclear, fossil, petrochemical, chemical, and hazardous waste plants and facilities **that can; (a) be integrated in the early stages of design, (b) advance as the design matures, and (c) provide structure to the initial development of a probabilistic risk assessment for advanced technologies and designs**. The focus is to provide requirements and guidance for hazard analysis and probabilistic risk assessment processes, methodologies and tools that will provide safer and more efficient system and component designs with quantified reliability levels.

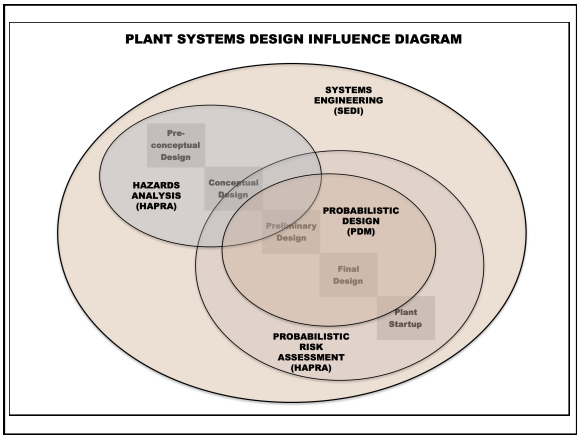
Charter: PSD Subcommittee on Systems Engineering Design Development Integration (SC SEDI)

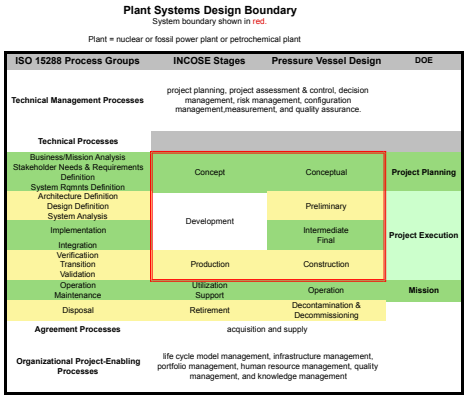
To develop, review and maintain technology neutral processes and procedures for design organizations to **incorporate and integrate existing systems engineering processes, practices and tools with traditional architect engineer design development processes, practices and tools** for design of nuclear, fossil, petrochemical, chemical, and hazardous waste plants and facilities. **This includes integration with enabling technical management processes and design development tools and databases.** The focus is to provide requirements and guidance for system development and design integration processes, methodologies and tools that will provide safer and more efficient system and component integrated designs with quantified reliability levels.

Enclosure 1

Charter: PSD Subcommittee on Probabilistic Design Methods (SC PDM)

To develop, review and maintain technology neutral processes and procedures for design organizations to **incorporate risk informed probabilistic design methodologies with traditional deterministic design methods using reliability and availability targets** for design of nuclear, fossil, petrochemical, chemical, and hazardous waste plants and facilities. The focus is to provide requirements and guidance for probabilistic design methodologies and tools that will provide safer and more efficient system and component designs with quantified reliability levels.





Where are we now?

PSD Standards Committee

- Approved by BNCS and CSC
- Membership and Chair approved by BNCS
- Committee Page established on C&S Connect
- Procedure Supplement drafted for committee approval

Proposed PSD Subcommittees

- HAPRA, SEDI and PDM have been conducting Zoom meetings to develop roadmaps and flowcharts since May
- Subcommittees, their charters, membership and leadership were approved at July 10 meeting
- Committee pages established on C&S Connect

Where are we going? (1 of 3)

Complete PSD Development Planning

- Complete draft HAPRA, SEDI & PDM roadmaps
  - Target date 10/27/2019 – Atlanta F2F Meetings
- Complete draft integrated PSD roadmap
  - Target date 01/25/2020 – Torrance F2F Meetings
    or 02/02/2020 – Las Vegas F2F Meetings
- Complete draft HAPRA, SEDI & PDM WBS definitions
  - Based on 10/2019 draft roadmaps
  - Target date Jan/Feb 2020 F2F Meetings
- Complete draft integrated PSD WBS definitions & project schedule including BNCS stage gates
  - Target date July/Aug 2020 F2F Meetings

Where are we going? (2 of 3)

Write the PSD Standard

- Draft HAPRA, SEDI & PDM sections
  - Target date IAW with integrated project plan and schedule
- Conduct in-process integration reviews
  - Target date IAW with integrated project plan and schedule
- Subcommittees ballot final drafts
  - Target date IAW with integrated project plan and schedule
- Standards committee ballots final drafts
  - Target date IAW with integrated project plan and schedule
- Public Review and Comment
- Publish PDM Standard

ASME Editors to be involved in all of the above.

Enclosure 1

Where are we going? (3 of 3)

Parallel Activities to "Write the Standard"

- JCNRM SCORA develops standard for development of target reliabilities
  - Target dates IAW with integrated project plan and schedule
- SWG Regulatory Interface pursues harmonization of nuclear, fossil, petrochemical, chemical, and hazardous waste plant and facility safety goals for acceptance of processes and procedures incorporated in the PSD including risk tolerance in relation to plant systems design and target reliabilities for probabilistic design
  - Target dates IAW with integrated project plan and schedule
- SC Conformity Assessment develops performance based personnel certification, capability maturity model, and similar processes and programs, which evaluate the capabilities of design organizations to implement processes and procedures specified in the PSD
  - Target dates IAW with integrated project plan and schedule

Questions ?

Background Slides

ANS 30.1 Content

Provide consistent RIPB framework across all new reactor technologies

- Address early design when PRA not practical to prepare
- Provide general requirements that are sufficient and necessary in a process to develop a robust RIPB reactor design (conceptual)
  - Develop principle design criteria
  - Use a systems engineering process
  - Use a quantitative process to evaluate defense in depth
  - Evaluate design(s) using sequence-based assessments
- Objective is to get these concepts into the minds and processes of the designers so they do not have problems after conceptual design

EPRI Body of Knowledge (BoK)

Early Integration of Safety Assessment into Advanced Reactor Design Preliminary Body of Knowledge and Methodology

Reactor developers seeking advanced reactor design certification and/or licensing face challenges in developing a safety case because many designs come with limited to no commercial operating experience, incorporate novel design elements, and may include unique radioactive material inventories as well as other non-traditional hazards.

EPRI BoK – Key Findings 1 of 3

- Sufficient experience exists for conducting analyses early and throughout the design of advanced reactors using tools and methods that are not limited by their legacy of application to specific technologies and regulatory mindsets.
- The PHA-to-PRA process is likely to begin by focusing on subsets of systems (or subsystems) that have been selected on the bases of available information and anticipated relative importance to safety risk, performance risk, cost and schedule to develop, and cost to change.

Enclosure 1

EPRI BoK Key Findings (2 of 3)

- Experience to date with the development of a structured approach to the application of standard hazard assessment methods suggests substantial benefit and value are realized through the following:
  - Comprehensive identification of physical and chemical phenomena important to safety
  - Early and iterative utilization of PHA and quantitative consequence analysis
  - Incremental development of PRA building blocks

EPRI BoK Key Findings (3 of 3)

  - Identification of technology-relevant risk metrics
  - Early institution of systems engineering in order to perform industry-standard PHA studies of systems, subsystems, and their interfaces
  - Early establishment of a working interface between safety and engineering technologists
- Support for development and implementation of risk-informed, performance-based design and licensing practices

ASME 2025 Nuclear Construction Code (NCC)

Key Concepts related to this Standard

Concept 3: Content will in parallel with current Code in a **single controlled relational database where each requirement is entered once and then allocated to applicable components.**

Concept 4: A subsequent edition of the 2025 NCC will add **risk-informed design methods**, including reliability and availability targets

BPTCS TG Risk-Based Design 1 of 4

- Formed to develop a general procedure for implementing risk analysis methods for ASME Boiler and Pressure Vessel Code Sections I and VIII.
- It is also tasked with providing specific recommendations for the use of risk in the design, inspection, and examination activities specified in the Section I, “Power Boilers” and Section VIII “Pressure Vessels” construction codes.

BPTCS TG Risk-Based Design 2 of 4

GOALS

- Develop a guidance document (report) for the BPTCS Construction Committees (BPV I, BPV VIII, and BPV XII) on the incorporation of risk into their documents.
- Review each Construction Code for risk-rules:
  - Identify locations where risk-based rules could be added, such as specific Sections, paragraph numbers, appendices
  - Identify issues that require attention, such as a revision of design calculations to identify embedded design margins
- Drafting of specific Code language will be performed by the appropriate Construction Code.

BPTCS TG Risk-Based Design 3 of 4

Guidance Document Draft Outline

- Discussion on Risk
- Roles of Parties
- Design Analysis Methods
- Materials Variability
- NDE Effectiveness
- Load Distribution (Upsets)
- Service Fluid / Lethal Service Considerations
- Other Consequential Damage Considerations
- Examples

Enclosure 1

BPTCS TG Risk-Based Design 4 of 4

Expected Timing

- Anticipate that a completed draft will be available for Task Group review by year end 2019.
  - Document drafting is on-going
  - Sections are assigned to teams of TG Members and Interested Parties
  - Draft sections are then reviewed during the face-to-face Boiler Code Week meeting

Section XI, Div. 2, RIM 1 of 3

- addresses a plants' entire life cycle
- applicable over entire life of plant and each passive SSC in scope
- requires a combination of monitoring, examination, tests, operation, and maintenance requirements that ensure SSCs meet the plant risk and reliability goals (i.e., Reliability Targets) selected for the RIM Program
- only addresses passive SSCs

Section XI, Div. 2, RIM 2 of 3

RIM process consists of the following steps:

1. RIM Program scope definition
2. Degradation Mechanism Assessment
3. Plant and SSC Reliability Target allocations originating from the PRA
4. Identification and evaluation of RIM strategies
5. Evaluation of uncertainties
6. RIM Program implementation
7. Performance monitoring and RIM Program updates

Section XI, Div. 2, RIM 3 of 3

Status:

- Record 18-890
- BNCS approved 12/14/2018 on Ballot 18-3609

ASME Plant Systems Design Roster

LAST	FIRST	1st Committee	Member Type	2nd Committee	Member Type	COMPANY	Primry Area of Interest (see below)
Crane	Ryan	-	-	-	-	ASME Staff	All
Hill	Ralph	PSD SC	Chair			Hill Eng Solutions	All
Manoly	Kamal	PSD SC	Member			NRC	All
Miro-Quesada	Daniel	PSD SC	Secretary			ASME Staff	All
Finney*	Ned			SC CA	Contributing	Duke Energy	CA
Smith	Clay			SC CA	Contributing	Smith Associates	CA
Bristol	Sarah			SC HAPRA	Member	NuScale Power	HAPRA
Grantom	Carl	PSD SC	Member	SC HAPRA	Member	Grantom & Assoc.	HAPRA
Jansen Vehec	Jodine	PSD SC	Member	SC HAPRA	Chair	JTV Nuclear Consultants	HAPRA
Krahn	Steve			SC HAPRA	Contributing	Vanderbilt	HAPRA
Miyaguchi	Haruei			SC HAPRA	Member	IHI Corp.	HAPRA
Morris	Dave	PSD SC	Member	SC HAPRA	Vice Chair	Dave M Consultancy	HAPRA
Nelson	Pamela			SC HAPRA	Secretary	UNAM	HAPRA
Phan	Hahn			SC HAPRA	Member	NRC NRR	HAPRA
Sims	Bob	PSD	Member	SC HAPRA	Member	Becht Engineering	HAPRA
Snedeker	Garrett	PSD	Member	SC HAPRA	Member	Framatome	HAPRA
Sowder	Andrew			SC HAPRA	Contributing	EPRI	HAPRA
Takaya	Shigeru			SC HAPRA	Member	JAEA	HAPRA

ASME Plant Systems Design Roster

Williams	Cindy			SC HAPRA	Alt S. Bristol	Nuscale	HAPRA
Tschiltz	Mike			???		NEI	HAPRA
Burkhardt	Ken	None				Dupont	Info
Coppel	Roger	None				Sargent & Lundy	Info
Erler	Bryan	None				Erler Eng.	Info
Geier	Stephen	None				NEI	Info
McLaughlin	Bob	None				Consultant	Info
McReynolds	Bob			???		Kairos Power	Info
Pastor	Tom					HSB	Info
Roberts	Steve					Shell	Info
Arnold	John			???		Niantic Bay Engineering, LLC	PDM
Fong	Jeffrey			SC PDM	Member	Argonne National Laboratory	PDM
Golliet	Matt			SC PDM	Member	Westinghouse	PDM
Hakii	Junichi			SC PDM	Member	TEPCO	PDM
Haupt	Ron			SC PDM	Member	Pressure Piping Engineering	PDM
Keating	Bob	PSD SC	Contributing	SC PDM	Contributing	MPR	PDM
Martin*	Aaron			SC PDM	Member	Terra Power	PDM
Matthews	Dale	???		???		Framatome	PDM
Ng	Ching			SC PDM	Member	NRC	PDM
Pellereau	Ben	PSD SC	Member	SC PDM	Chair	Rolls Royce	PDM
Prinja*	Nawal			???	Member	Wood pic (Nuclear)	PDM

Sham	Sam			SC PDM	Member	Argonne National Laboratory	PDM
Smith	Paul	PSD SC	Contributing	SC PDM	Member	Wood pic (Nuclear)	PDM
Williams	Simon			SC PDM	Contributin	Rolls Royce	PDM
Wright	Keith	PSD SC	Contributing	SC PDM	Member	Rolls Royce	PDM
Yada	Hiroki			SC PDM	Member	JAEA	PDM
Donavin*	Paul			SC RI	Chair	Engineering Management	RI
Prinja	Nawal	PSD SC	Member	SC RI	Member	Wood pic (Nuclear)	RI
Williams*	Simon			SC RI	Member	Rolls Royce	RI
Ashley	Clinton			SC SEDI	Member	NRC	SEDI
Barnes	Dick	PSD SC	Member	SC SEDI	Member	ANRIC	SEDI
Cardillo	Augie			SC SEDI	Member	True North Consulting	SEDI
Chugh	Vinod	PSD SC	Member	SC SEDI	Member	Kairos Power	SEDI
Corwin	Bill			SC SEDI	Contributing	Consultant (DOE)	SEDI
Delamare	Michael	PSD SC	Member	SC SEDI	Member	Bechtel Corporate	SEDI
Donavin	Paul	PSD SC	Member	SC SEDI	Member	Engineering Management	SEDI
Finney	Ned			SC SEDI	Member	Duke Energy	SEDI
Harkey	Natalie	PSD SC	Member	SC SEDI	Vice Chair	Bechtel NS&E	SEDI
Hastings	Carl	PSD SC	Member	SC SEDI	Chair	Consultant	SEDI
Liszkai	Tamas	PSD SC	Contributing	SC SEDI	Contributing	NuScale Power	SEDI
Martin	Aaron	PSD SC	Member	SC SEDI	Member	Terra Power	SEDI
Milankov	Peter			SC SEDI	Secretary	ANRIC	SEDI

Matsunaga	Keiji	**PSD SC**	**Contributing**	SC SEDI	Contributing	Toshiba ESS	SEDI
Mattson	Liz			SC SEDI	Contributing	Sargent & Lundy	SEDI
Pressburger	Maury			SC SEDI	Contributing	Sargent & Lundy	SEDI
Ritter	Chris	PSD SC	Member	SC SEDI	Member	Idaho National Laboratory	SEDI
Solovey	Garrick	PSD SC	Contributing	SC SEDI	Member	Consultant (Manufacturing)	SEDI
Unikewicz	Steve	PSD SC	Member	SC SEDI	Member	Southern Company	SEDI
Vogan	Tom			???		Consultant	SEDI
Willoughby-Braun	Selena	PSD SC	Contributing	SC SEDI	Contributing	Westinghouse	SEDI