Overview and Practical Application of the Plant Parameters Envelope (PPE) Approach for Early Site Permit Applications

Presentation to NRC Staff
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Presentation Outline

- Introduction and background
- Plant parameters envelope approach
- Origin and development of PPEs
- PPE worksheet
- Examples

What is a PPE?

- "Plant parameters envelope"
  - The set of postulated design parameters that bound the characteristics of a reactor or reactors that might later be deployed at a site
  - Used to obtain an Early Site Permit when the type of plant to be built has not been determined

Two ESP Scenarios

- ESP application specifies design characteristics for the specific facility to be built

- ESP application specifies postulated design parameters as a surrogate for actual facility information

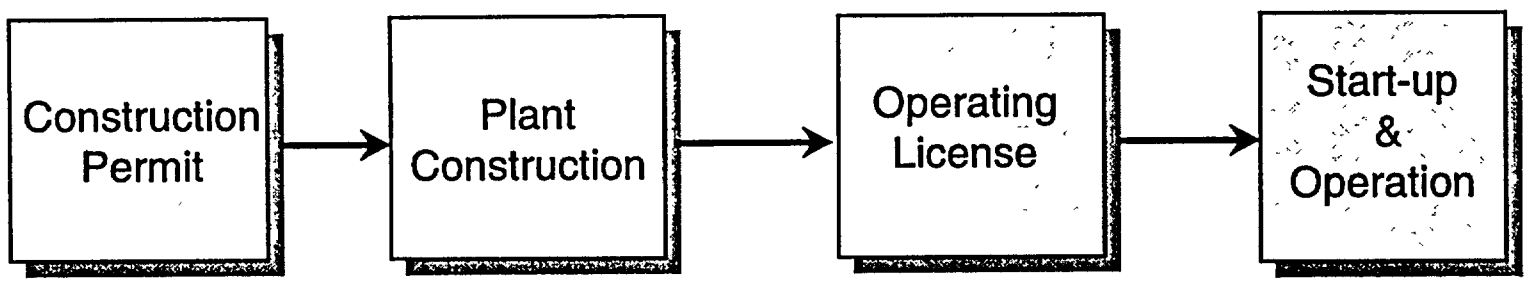
Background

- Licensing Past
  - Plants and sites were evaluated together for Part 50 construction permits and operating licenses

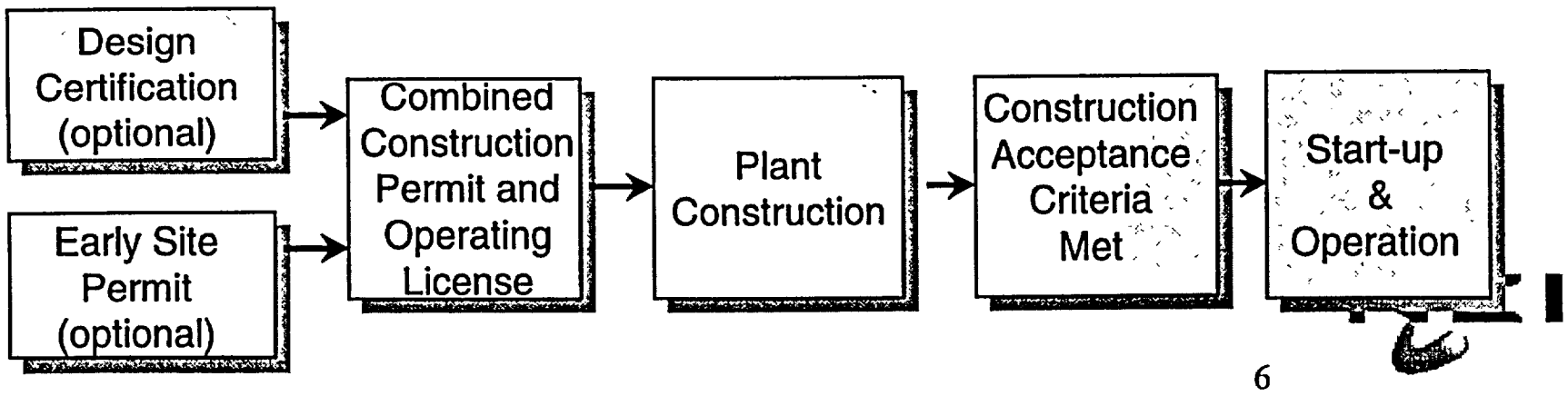
- Licensing Future
  - Part 52 provides for separate NRC approvals for standard plant designs and sites, well in advance of any decision to build an actual plant
  - Combined license applications under Part 52 may reference an existing design certification and/or early site permit, or neither

Old Licensing Process vs. New

Part 50



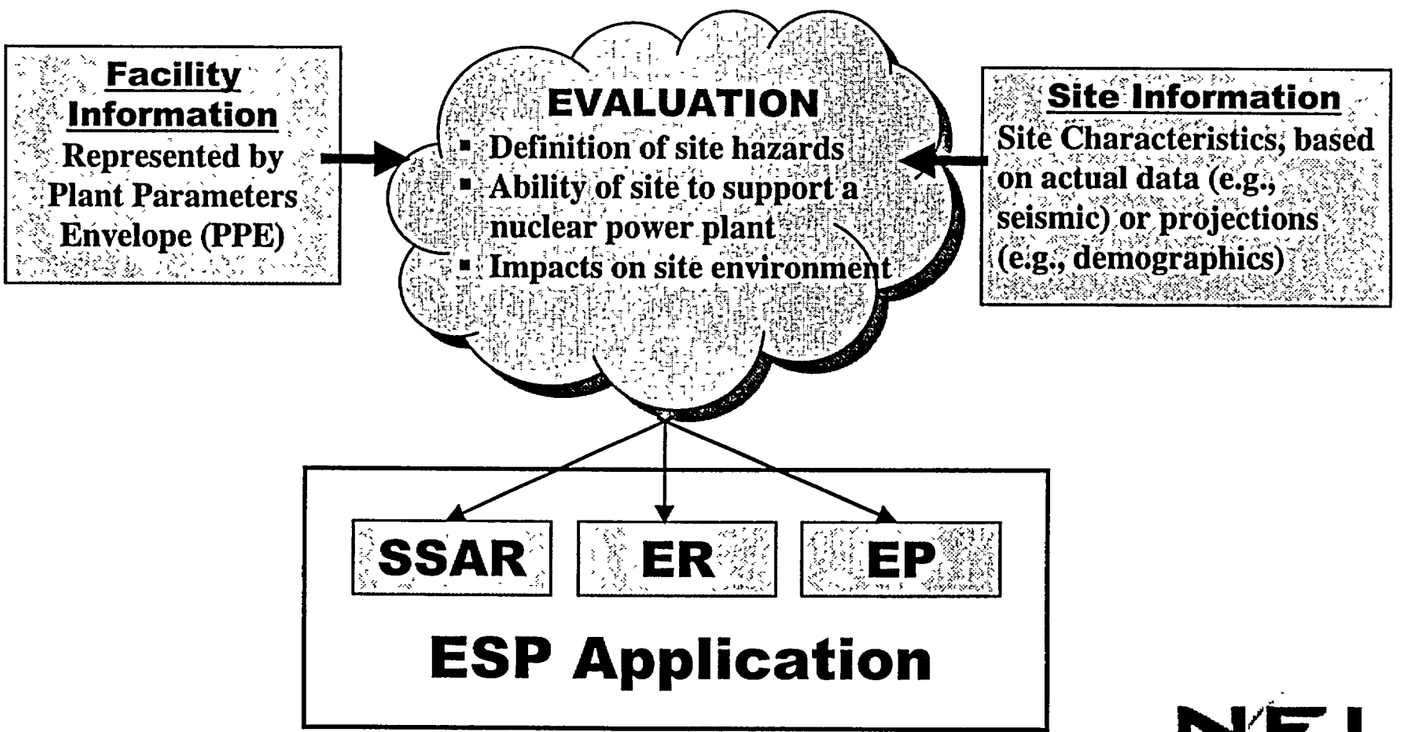
Part 52



Necessary Assumptions

- Early design and site approvals under Part 52 require making certain assumptions
  - Design certifications assumed a suite of "site parameters" to enable design development and safety reviews, e.g.,
    - Seismic accelerations
    - Maximum precipitation, flood level, wind speed
    - Soil properties, etc.
  - For early site permits that do not specify facility type, an array of "design parameters" must be assumed to facilitate site suitability evaluations, e.g.,
    - Cooling water requirements
    - Acreage/footprint
    - Effluents and releases

The PPE Approach



PPE Values

- Design parameter values are chosen to bound a range of possible future facilities that might one day be built, including
  - NRC certified designs
  - Designs in progress
  - Future designs

Dual Advantages of PPE Approach

- Provides essential flexibility to future COL applicants to select the best technology at the time a decision to build is made
  - ESPs are valid for up to 20 years and are renewable
- Provides NRC with the technical basis for its review and issuance of ESPs

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ESP/Part 52 Terminology

Term	Definition
Site parameters	The postulated physical, environmental and demographic features of an as-yet unidentified site
Design parameters	The postulated features of the reactor or reactors that could be built
Site characteristics	The real physical, environmental and demographic features of the proposed facility location
Design characteristics	The real features of a reactor or reactors

ESP Applications

- ESP applications will include two main types of info:
  - Site characteristics: The real physical, environmental and demographic features of the proposed facility location.
    - Established through data collection and/or analysis
    - Developed in accordance with NRC requirements and guidance
  - Design parameters: The postulated features of the reactor or reactors that could be built.
    - Design information that is necessary to prepare and review an ESP application.
- ESP applications, including the site characteristics and the PPE, must provide sufficient information to support required safety and environmental reviews by NRC

Envisioned Focus of NRC Reviews

- "Site characteristics" will be reviewed to ensure they completely and accurately describe the site

- Bounding "design parameters" (PPE values) will be used to determine that associated safety and environmental impacts are acceptable for the site

Key Expected NRC Findings for ESP

- **Site characteristics are complete and accurate**
- **Scope of design parameters is sufficient** for purposes of required site safety and environmental reviews
- **The site is acceptable** for construction and operation of reactor(s) having characteristics that fall within the identified site characteristics and design parameters

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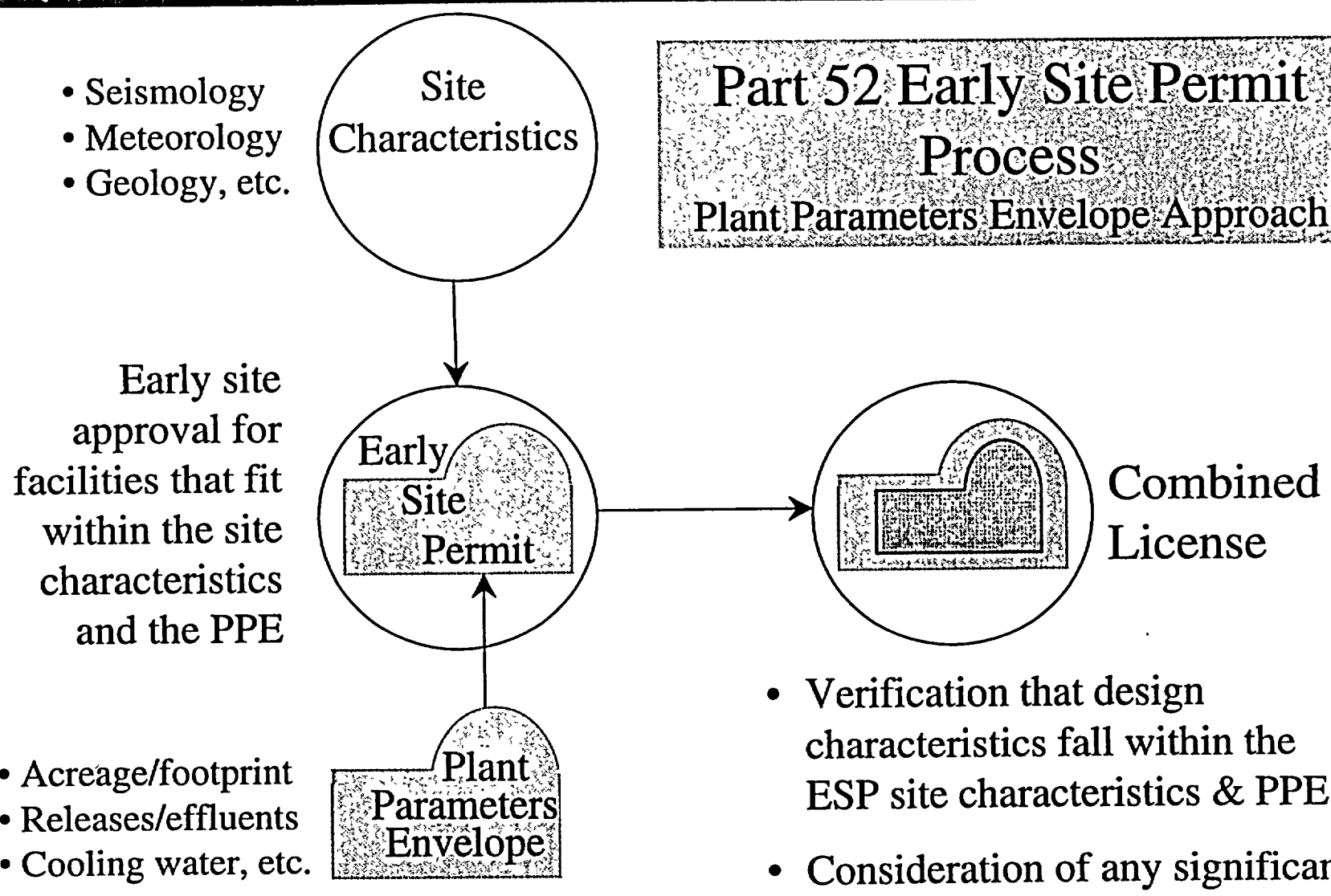
Part 52 Early Site Permit Process
Plant Parameters Envelope Approach



Origin of PPE

- Need for the PPE approach was recognized in the early 1990s
- Developed by the joint industry/DOE Early Site Permit Demonstration Project (ESPDP)
- Current pilot ESP applicants are picking up where the ESPDP left off

Systematic Development of PPEs

- Appropriate plant parameters were developed through a systematic review of
  - Regulatory criteria
  - Application content criteria
  - Consideration of previous site studies
  - Design and construction experience

Systematic Development (cont.)

- Design certification-related information was screened out. The remaining information related more to siting, and formed an initial group of design parameters
- Quantitative values were assigned to the design parameters using available information
- The resulting PPE worksheet effectively became a representation of the SSCs that would comprise a surrogate facility for siting purposes

PPE Worksheet

- The current PPE worksheet is presented as a multi-page table
- Plant parameters are listed down the left-hand column
- Values for various technologies, *as selected by the applicant*, appear in the middle columns, along with footnotes

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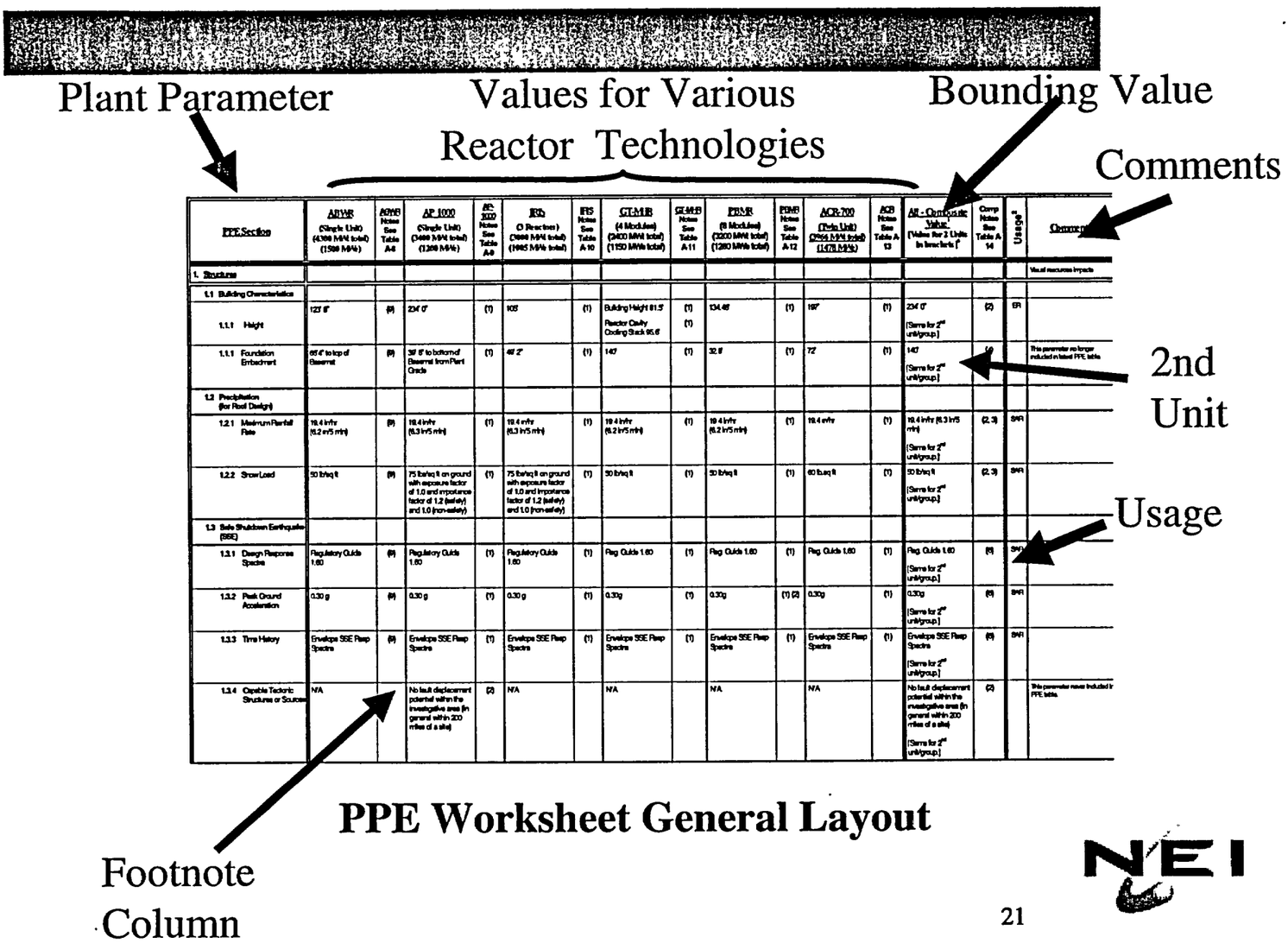
PPE Worksheet (cont.)

- Footnotes are extensively used
- Right-hand columns identify
  - The bounding values
  - The parameter's usage in the ESP application
  - Comments
- Bounding values are submitted as part of the ESP application



PPE Section	ABWR (Single Unit) (4300 MW total) (1500 MW)	ABWR Notes See Table A-8	AP 1000 (Single Unit) (3400 MW total) (1200 MW)	AP 1000 Notes See Table A-9	IRIS (2 Reactors) (1900 MW total) (1965 MW total)	IRIS Notes See Table A-10	GT-MHR (4 Modules) (2400 MW total) (1150 MWe total)	GT-MHR Notes See Table A-11	PBMR (8 Modules) (3200 MW total) (1280 MWe total)	PBMR Notes See Table A-12	ACR-700 (Twin Unit) (2944 MW total) (1476 MW)	ACR Notes See Table A-13	Alt - Composite Value (Values for 2 Units in brackets)[a]	Comp Notes See Table A-14	Usage[b]	Comments
1. Structures																Visual resources impacts
1.1 Building Characteristics																
1.1.1 Height	127 ft	(9)	234' 0"	(1)	105	(1)	Building Height 81.5' Reactor Cavity Cooling Stack 95.6'	(1) (1)	134.48'	(1)	197'	(1)	234' 0" [Same for 2nd unit/group.]	(2)	ER	
1.1.1 Foundation Embedment	65' 6" to top of Basemat	(9)	39' 8" to bottom of Basemat from Plant Grade	(1)	48' 2"	(1)	140'	(1)	32 ft	(1)	72'	(1)	140' [Same for 2nd unit/group.]	(9)		This parameter no longer included in latest PPE table.
1.2 Precipitation (for Roof Design)																
1.2.1 Maximum Rainfall Rate	19.4 in/hr (8.2 in/5 min)	(9)	19.4 in/hr (8.3 in/5 min)	(1)	19.4 in/hr (8.3 in/5 min)	(1)	19.4 in/hr (8.2 in/5 min)	(1)	19.4 in/hr (8.2 in/5 min)	(1)	19.4 in/hr	(1)	19.4 in/hr (8.3 in/5 min) [Same for 2nd unit/group.]	(2, 3)	SNR	
1.2.2 Snow Load	50 lb/sq ft	(9)	75 lb/sq ft on ground with exposure factor of 1.0 and importance factor of 1.2 (safety) and 1.0 (non-safety)	(1)	75 lb/sq ft on ground with exposure factor of 1.0 and importance factor of 1.2 (safety) and 1.0 (non-safety)	(1)	30 lb/sq ft	(1)	30 lb/sq ft	(1)	60 lb/sq ft	(1)	50 lb/sq ft [Same for 2nd unit/group.]	(2, 3)	SNR	
1.3 Safe Shutdown Earthquake (SSE)																
1.3.1 Design Response Spectra	Regulatory Guide 1.60	(9)	Regulatory Guide 1.60	(1)	Regulatory Guide 1.60	(1)	Reg. Guide 1.60	(1)	Reg. Guide 1.60	(1)	Reg. Guide 1.60	(1)	Reg. Guide 1.60 [Same for 2nd unit/group.]	(9)	SNR	
1.3.2 Peak Ground Acceleration	0.30 g	(9)	0.30 g	(1)	0.30 g	(1)	0.30g	(1)	0.30g	(1) (2)	0.30g	(1)	0.30g [Same for 2nd unit/group.]	(9)	SNR	
1.3.3 Time History	Envelope SSE Resp Spectra	(9)	Envelope SSE Resp Spectra	(1)	Envelope SSE Resp Spectra	(1)	Envelope SSE Resp Spectra	(1)	Envelope SSE Resp Spectra	(1)	Envelope SSE Resp Spectra	(1)	Envelope SSE Resp Spectra [Same for 2nd unit/group.]	(9)	SNR	
1.3.4 Capable Tectonic Structures or Sources	N/A		No fault displacement potential within the investigative area (in general within 200 miles of a site)	(2)	N/A		N/A		N/A		N/A		No fault displacement potential within the investigative area (in general within 200 miles of a site) [Same for 2nd unit/group.]	(2)		This parameter never included in PPE table.

PPE Worksheet General Layout

Examples

Example #1

- The plant parameter is "building height"
- Building height is not used in the Site Safety Analysis Report
- Building height is not used in radiological release evaluations
- Building height is used in the following sections of the Environmental Report
  - Section 3.1, External Appearance and Plant Layout
  - Section 5.8.1, Physical Impacts of Station Operation

Example #1 (cont.)

Plant Parameter: 1.1.1 Building Characteristics, Height

Definition: The height in feet from finished grade to the top of the tallest power block structure (excluding cooling towers)

	ABWR	AP-1000	IRIS	GT-MHR	PBMR	ACR-700	Bounding Value	Usage
Building Height	123'8"	234'0"	105'	81.5' Reactor Cavity Cooling Stack 95.8'	134.48'	197'	234'0"	ER

- This applicant selected six technologies
- The tallest building height was chosen as the bounding value because of its use in the aesthetic ER assessment

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Example #1a

Plant Parameter: Height

Definition: The height in feet from finished grade to the top of the tallest power block structure (excluding cooling towers)

	ABWR	AP-1000	IRIS	GT-MHR	PBMR	ACR-700	Bounding Value	Usage
Height	123'8"	234'0"	196'	81.5' Reactor Cavity Cooling Stack 95.8'	134.48'	197'	197'	ER

This applicant selected four technologies to establish a different bounding parameter value of 197 ft.

Example #2 (cont.)

- The plant parameter is "cooling tower height"
- There are different types of cooling towers. The bounding value differs based on type
- In one instance, margin is added
- The parameter is used in environmental evaluations involving aesthetics and non-radiological plume analyses

Example #2 (cont.)

Plant Parameter: 2.4.8 Mechanical Draft Cooling Tower Height, or 2.5.8 Natural Draft Cooling Tower Height

Definition: The vertical height above finished grade of either natural draft or mechanical draft cooling towers associated with the cooling water systems.

	ABWR	AP-1000	IRIS	GT-MHR	PBMR	ACR-700	Bounding Value	Usage
Mechanical Draft CT Height	60 ft	60 ft	60 ft	55 ft	60 ft	60 ft	65 ft	ER
Natural Draft CT Height	550 ft	500 ft	550 ft	N/A	490 ft	550 ft	550 ft	ER
Selection A							65 ft	
Selection B							550 ft	

Note that the applicant may limit the types of cooling systems utilized at the site by the selection of parameters.

Example #2 (cont.)

- In Examples 1 and 2, there is no corresponding site characteristic
- The PPE bounding value is compared to appropriate regulatory criteria to determine the acceptability of the site
- The applicant would seek NRC approval <u>that the environmental impact associated with</u> the PPE value <u>is acceptable</u>
- Now lets examine a parameter that also involves a site characteristic

Example #3

- The site characteristic is "snow load"
- The vendors have each assumed certain snow loads for their designs
- Snow load is used in the site safety analysis report to address regional climatology

Example #3 (cont.)

Plant Parameter: 1.2.2, Snow Load

Definition: The maximum load on structure roofs due to the accumulation of snow.

	ABWR	AP-1000	IRIS	GT-MHR	PBMR	ACR-700	Bounding Value	Usage
Snow Load	50 lb/sq ft	75 lb/sq ft	75 lb/sq ft	50 lb/sq ft	50 lb/sq ft	60 lb/sq ft	50 lb/sq ft	SAR

- The applicant selects the lowest value (i.e., the minimum structural load) as the bounding value because it maximizes flexibility
- Applicant determines site characteristic value, e.g., 30 psf or 80 psf

Example #3 (cont.)

- Case A: The bounding value is compared to the site characteristic

Parameter	Bounding Value	Site Characteristic	Permit Basis
Snow Load	50	30	30

- Whenever there is a site characteristic, the applicant will seek approval of the site characteristic
- Case B: Where bounding values do not support the site characteristic, further action in design certification or combined license activities would be required

Parameter	Bounding Value	Site Characteristic	Permit Basis
Snow Load	50	80	80

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PPE Values, Site Characteristics, and the Permit Basis

Parameter	Bounding Value	Site Characteristic	Permit Basis
Building Height	234	None	**234**
Snow Load (Case A)	50	30	**30**
Snow Load (Case B)	50	80	**80**

- Applicants will submit a combination of bounding design parameter values and site characteristics
- The combination of bounding design parameter values and site characteristics form the "permit basis"

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