POLICY ISSUE
(Notation Vote)

July 11, 1990 SECY-90-241

For: The Commissioners

From: James M. Taylor
Executive Director for Operations

Subject: LEVEL OF DETAIL REQUIRED FOR DESIGN CERTIFICATION UNDER PART 52

Purpose: To present options for Commission consideration regarding the implementation of the provisions of 10 CFR Part 52 that address the level of design detail. The staff requests Commission guidance on this issue.

Background: On May 18, 1989, the Commission issued a new rule, 10 CFR Part 52, that provided for early site permits, certified standard designs, and combined construction permits and operating licenses. The intent of Part 52 in providing for the review and licensing of standard designs is to reform the licensing process by effecting early resolution of safety issues and to enhance the safety and reliability of nuclear power plants through standardization. In the April 27, 1990 Commission meeting, the issue of the level of detail required by Part 52 was discussed briefly. After the meeting, Staff Requirements Memoranda were issued which directed the staff to present a paper examining the level of detail required by Part 52 to facilitate design certification of an essentially complete design. In response, the staff examined the requirements of Part 52 and discussed the subject with industry representatives.

The staff is presenting the Commission with four levels of design detail in this paper. Our objectives are to present the technical and regulatory considerations pertinent to actions that might be taken by the applicant and the NRC

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at each level. The level of detail associated with a design certification can be considered in terms of three variables: (1) the contents of an application for design certification, (2) the material to be developed by the applicant and made available for audit, and (3) the information certified by rulemaking. Part 52 is clear regarding the scope of an application for design certification stating that, with some exceptions for reactors of advanced design, "Any person may seek a standard design certification for an essentially complete nuclear power plant design ..." An essentially complete design includes all structures, systems, and components which can affect safe operation of the plant except for site-specific elements such as the service water intake structure and the ultimate heat sink." Accordingly, scope is not addressed in this paper.

Discussion:

A. DESIGN DETAIL IN A CERTIFICATION APPLICATION

Section 52.47(a)(1) requires that an application for a design certification include a level of detail that would satisfy the regulatory requirements for technical information in an FSAR, except to the extent that particular requirements are technically irrelevant or site specific. Section 52.47(a)(2) addresses level of detail from three perspectives. First, the level of detail must permit NRC to reach a final conclusion on all safety questions associated with the design before certification. Second, the level of detail must be such to allow the applicant's proposed means of assuring that construction conforms to the design. The staff believes this, in conjunction with other provisions of Part 52, to require and define the purpose of inspections, tests, analyses, and acceptance criteria (ITAAC). Third, Section 52.47(a)(2) requires a level of detail in the application such that the application itself would contain sufficient information to permit the preparation of procurement and construction and installation specifications. The staff believes this provision should be met without recourse to significant additional design engineering. The staff reads this to require, for example, that ranges of values for analyses and tolerances for structures, systems and components be provided in the application.

B. DESIGN DETAIL TO BE AVAILABLE IF REQUESTED BY NRC

Section 52.47(a)(2) requires that information normally contained in certain procurement and construction and installation specifications be available for audit if the NRC needs to review the information in order to make a safety finding. The staff reads this to require a level of detail (e.g., value ranges and tolerances) refined beyond that included in the application.

C. DESIGN DETAIL IN THE CERTIFICATION

The rule indicates the information required to be in an application and to be developed and available for audit; it is, however, silent on the level of design detail that is to be a part of the certification itself. On this point, the Statements of Consideration says that "just how much [design detail] is present will be an issue which will have to be resolved in each certification rulemaking. The Commission does expect, however, that there will be less detail in a certification than in an application for certification, and that a rule certifying the design is likely to encompass roughly the same design features that Section 50.59 prohibits changing without prior NRC approval." The information present in a design certification will control the degree of standardization that can be achieved at the design certification stage. Some of the information contained in an application for design certification may represent commercial, proprietary information. If information of this type is included in the certification, the material will no longer be considered proprietary; instead it becomes part of the NRC's public requirements. Thus decisions about level of detail in the certification itself could have important consequences for the commercial value of vendor design information.

D. ITAAC

The applicant must develop inspections, tests, analyses, and acceptance criteria (ITAAC) and submit them for staff review as specified in Part 52.47(a)(1)(vi). ITAAC will provide reasonable assurance that a plant which references the design is built and will operate in accordance with the design certification. ITAAC are not a design tool to be used in lieu of the detailed information needed to satisfy the requirements for an application, as discussed above. The subject is discussed further in the enclosure to this paper.

E. POLICY ISSUE REGARDING "TWO-TIERED" CERTIFICATIONS

One other policy issue that is closely tied to the issue of level of design detail is whether the Commission should accept the "two-tiered" approach proposed by industry for design certification. In this approach, the top tier certified design would include essential safety performance criteria that, once certified, could only be changed by the receiving of an exemption through 10 CFR 50.12. A second tier of material would include more detailed design information. This second tier would be associated with the rule certifying the design (but not be part of the certification itself) and would include a change process like the current 10 CFR 50.59, that would allow changes without prior NRC review so long as no unreviewed safety question is presented.

The desired effect is that the approved Tier 2 design detail could not be challenged in the combined license proceeding except under 10 CFR 2.758 or to the extent the design is changed after the rulemaking under the Section 50.59 flexibility provisions. The constraints on backfitting and other provisions of Part 52 intended to foster standardization would not apply to the design approved in Tier 2. Although the two-tiered concept is presented in this paper in conjunction with the industry approach (Level 3), it may be applied to any of the options.

F. THE FOUR OPTIONS FOR LEVEL OF DESIGN DETAIL

The rule as promulgated allows for interpretation that could lead to a different body of information in each certification resulting in varying degrees of standardization. The more specific the engineering detail embedded in the design certification rule is, the greater the degree of standardization for that design.

The staff has examined four levels of detail, the corresponding degree of standardization achieved, compliance with Part 52, and the safety and economic benefits derived from each. The staff discusses each of these levels in the next few pages. These levels are merely examples of the level of detail that can be included in the application and the degree of standardization that can be achieved through the certification process and are not necessarily the only options available to the Commission under Part 52. It is not clear that the design detail necessary to realize a Level 1 degree of standardization is consistent with Part 52 regarding the content of the application. Notwithstanding a rule change to Part 52, the first level is probably not commercially feasible, because the level of detail required in a Level 1 certification would make it difficult to assure continued availability of components with all the certified attributes over the life of certification. Level 2 provides the maximum degree of standardization while avoiding to some extent the aforementioned concern. The third level of detail presented characterizes the industry proposal (incorporating the two-tiered approach) as the staff understands it. NUMARC are the only ones who can speak definitively on their position. The fourth level of detail (product-line standardization) would not constitute an acceptable application for design certification under the current provisions of Part 52, because it is not sufficient to allow the staff to reach its final conclusion on all safety issues in a one-step process. However, it is provided to exemplify a level of detail and standardization achieved under the Part 50 process.

In Levels 1, 2, and 3, the content of the application in terms of information germane to our safety findings is the same; however, the scope and depth of detail required for Levels 1 and 2 will be beyond what the staff has traditionally needed to conduct licensing reviews under NUREG-0800 the Standard Review Plan (SRP). This greater level of detail will be provided for the sake of standardization. To the extent the greater level of detail is approved by rule in the certification process, there is also an earlier resolution of any safety issue associated with the design. Staff licensing review of an application for design certification for all levels will deviate somewhat from traditional practice, with the addition of the ITAAC, and in Levels 1 and 2, the standardization portion of the review as well. Additional guidance will have to be developed to support staff review. Information normally contained in procurement specifications and in construction and installation specifications and audited will be included or referenced in the application for a design certification if it is necessary for the staff to make its safety findings. In Levels 1 and 2 essentially the entire application will be certified. In Level 3 the design certification will contain much less detail than provided in Levels 1 and 2, plus the rulemaking approval of Tier 2 along with the industry-proposed Section 50.59-type change mechanism.

Using the HVAC system as an example, Table 1 shows how much detail we would expect for each of the four levels.

LEVEL 1

The degree of standardization resulting from this level of detail and the certification process will provide identical physical, functional, and performance characteristics of all structures, systems and components except for site specific characteristics.

In the Application

The application must satisfy the requirements of 10 CFR 52.47(a) and (b) (invoking Parts 20, 50, 73, and 100) and must provide resolutions for the technical issues discussed in SECY 90-016. The depth of design detail in the application for design certification will be all the information contained in a completely designed plant. This includes procurement specifications as well as construction and installation specifications for all structures, systems, and components (not including site-specific details) appropriate for soliciting fixed-cost construction bids. The design could be advanced through the procurement specification stage for all plant equipment. In some cases these procurement specifications will need to be more detailed and specific than is current practice to be able to ensure that the geometries, as well as the capabilities, of components are within specified ranges. The application will contain, for example, performance characteristics for all systems and their components; exact piping routing and support details for all systems; and physical location, characteristics, configuration, and orientation for all components on those systems. In other words, for all pumps on all systems not site related, the type (positive displacement or centrifugal), location, and pumping capacity and head will be specified, as well as the exact locations of the inlet and outlet nozzles, weight, size, shape, and mounting/supporting details.

If information obtained during the Staff review question and answer process forms the basis for a safety judgment or contributes to standardization, it will be included in the application.

Available for Audit

Information normally contained in procurement specifications and in construction and installation specifications will be included in the application. Therefore, audits should not be necessary.

In the Certification

The design certification will include essentially all of the material in the amended application, including the ITAAC, necessary for the staff to (1) determine design acceptability, (2) ensure design criteria and performance requirements are satisfied, (3) make a safety determination, and (4) ensure total plant standardization (minus site specific aspects) and its resulting safety benefits.

Remarks

To ensure that future plants will have identical physical, functional, and performance characteristics, the design will be developed and certified to a level of detail that includes all engineering data for a completely designed plant except for that data relating to site specifics. The application and design certification process will drive the design development and solidify it to a point where total plant standardization (except for site specifics) is achieved. As previouly stated, certain procurement specifications will have to be more detailed than is current practice. In some instances vendors may have to custom build such components as pumps, to fit the specifications. To require this much design detail is the most costly (greater than $600 million), initially, and may discourage NSSS vendors from entering the market; however, this much design detail will also result in more accurate determination of cost to the customer (utility). Certifying this level of detail provides the greatest regulatory stability (protection against unwarranted backfits) and early and final resolution of issues through design certification. Unavailability of specific components, resolution of construction deviations, and instances of highly desirable upgrades in technology that would provide equivalent or improved functionality or reliability can only be accommodated to a very limited extent through the granting of an exemption to the rule certifying the design via 10 CFR 50.12. The application will include a substantial amount of information beyond that traditionally needed to conduct a licensing review in accordance with the SRP. Staff review will deviate significantly from traditional practice, with the addition of the ITAAC and standardization portions of the review. Additional staff guidance would need to be developed to support the review of this information. Because the Level 1 status of design may exceed the requirements of Part 52, changes to the regulations would need to be considered were this option selected.

LEVEL 2

The degree of standardization resulting from this level of detail and the certification process will provide physically similar, and identical functional and performance characteristics of all structures, systems, and components affecting safety, except for site specific characteristics.

In the Application

The application must satisfy the requirements of 10 CFR 52.47(a) and (b) (invoking Parts 20, 50, 73, and 100) as well as provide resolutions for the technical issues discussed in SECY 90-016. The depth of design detail submitted in the application for design certification will be similar to that of a final safety analysis report (FSAR) at the operating license (OL) stage for a recently licensed (1989 - 1990) plant minus site-specific and as-built information. The application will provide design criteria and bases, system descriptions, performance requirements, and component descriptions and characteristics in enough detail for the staff to make its final conclusions on all safety questions; it will also contain information necessary to provide enhanced safety benefits from standardization. This includes a significant amount of design development and information necessary to finalize procurement specifications and construction and installation specifications for structures, systems, and components affecting safety. The application will contain, for example, performance characteristics for systems affecting safety and their components; general pipe routing (one line diagrams, such as P&IDs) for systems affecting safety; and relative physical location and characteristics of components on those systems. This differs from the Level 1 option which requires the same detail for all systems as well as exact physical location, configuration, and orientation of components and supports. In other words, for all pumps on systems affecting safety, the type, pumping capacity and head, and certain general physical attributes (e.g., centrifugal pump) will be specified; but the exact locations of the inlet and outlet nozzles, exact weight, and mounting/supporting details will not be supplied.

If information obtained during either the Staff review question and answer process or the audit forms the basis for a safety judgment, it will be included or referenced in the application.

Available for Audit

Consistent with Part 52, that information normally contained in procurement specifications and in construction and installation specifications shall be completed and available upon staff request. Audits will be conducted as necessary to support safety judgements and further standardization.

In the Certification

The design certification will include all of the material submitted in the initial application, including the ITAAC, necessary for the staff to (1) determine design acceptability, (2) ensure design criteria and performance requirements are satisfied, (3) make a safety determination, and (4) advance standardization and its resulting safety benefits.

Remarks

To ensure that plants will have physically similar, and identical functional and performance characteristics, the design must be developed and certified to a level of detail that includes all engineering data necessary to permit the preparation of procurement specifications as well as construction and installation specifications except for data that must be site-specific. Unlike the Level 1 option that will standardize essentially the entire plant to the component level (with physical attributes, orientation, and location specified), the Level 2 option will result in standardizing component descriptions and performance characteristics for all systems affecting safety. Although to require this amount of detail is initially costly (more than $400 million) and may discourage vendors from entering the market, cost can be more accurately determined, a benefit to the customer (utility). Certifying this level of detail provides regulatory stability and early and final resolution of issues through design certification. Unavailability of specific components, necessary construction deviations, and instances of highly desirable improvements in technology (and even new technologies) that would provide equivalent or improved functionality or reliability, will, to some extent, require the granting of an exemption to the rule certifying the design via 10 CFR 50.12. However, pursuant to Section 52.63(a)(2), a change may be made under the provisions of Section 50.59 "unless it involves a change to the design as described in the rule certifying the design." In the Level 2 option, only a small amount of information will not be certified, thus only a small portion will be subject to Section 50.59 changes. The application will include some additional information beyond that traditionally needed to conduct licensing reviews under the SRP, so as to advance standardization and provide the safety benefits derived from standardization. Staff licensing review of the application will deviate somewhat from traditional practice, with addition of the ITAAC and standardization portions of the review. Additional guidance will have to be developed for these portions of the review.

LEVEL 3

The degree of standardization resulting from this level of detail and the certification process will provide identical functional and performance characteristics of all systems, structures, and components, except for site-specific characteristics.

In the Application

The application must satisfy the requirements of 10 CFR 52.47(a) and (b) (invoking Parts 20, 50, 73, and 100) as well as provide resolutions for the technical issues discussed in SECY 90-016. The depth of design detail submitted in the application for design certification will be similar to that of an FSAR at the OL stage for a recently licensed (1989 - 1990) plant minus site-specific and as-built information. The application will contain design bases, system descriptions, performance requirements, design criteria, and other information in sufficient detail for the staff to make its final conclusions on all safety questions. This includes information necessary to permit the preparation of procurement specifications as well as construction and installation specifications for structures, systems, and components affecting safety. The application will contain, for example, performance characteristics for systems affecting safety; general piping locations for systems affecting safety; and general physical locations of major components for those systems affecting safety. Unlike the Level 2 option where we expect to have information (physical characteristics) for components on systems affecting safety, in the Level 3 approach, we will have performance characteristics on the major components for systems affecting safety.

If information obtained during either the staff review question and answer process or the audit forms the basis for a safety judgement, it will be included or referenced in the application.

Available for Audit

Consistent with Part 52, that information normally contained in procurement specifications and in construction and installation specifications shall be completed and available on request. Audits will be conducted as necessary to support safety judgments and will not be used to further standardization.

In the Certification

As in Levels 1 and 2, the design certification (Tier 1) and the associated approval considered together will include all information submitted in the initial application, including the ITAAC, necessary for the staff to (1) determine design acceptability, (2) ensure design criteria and performance requirements are satisfied, and (3) make a safety determination. Unlike Levels 1 and 2, Tier 2 will include a change mechanism, similar to the Section 50.59 process, to facilitate changes that do not decrease safety. The design material subject to this change mechanism (Tier 2), will be specified, by reference, and the remaining information in the design certification (Tier 1) will be changed only through the granting of an exemption via 10 CFR 50.12. The staff envisions that the material subject to the Section 50.12 process (Tier 1) will include only top level design criteria and performance standards similar to that presented in Chapter 1.2 of an FSAR at the OL stage.

Remarks

A significant amount of design information is still required to be submitted in an application for design certification. However, as a result of introducing the "two-tiered" concept and allowing changes to Tier 2 information similar to those allowed in Section 50.59, the degree of standardization ensured by the regulatory process in this approach will be confirmed essentially to the degree of detail in Tier 1 and will be lower than that realized by the Level 1 and 2 approaches. However, at a minimum, Level 3 still provides identical functional and performance characteristics. The initial cost to the applicant ($150 million - $350 million) is low compared to the cost of a developing Level 1 application.

Solidifying only the top level design criteria and performance standards (Tier 1) will yield greater flexibility to modify, via the Section 50.59-type change process, the remaining Tier 2 information. This will allow for construction fit-up changes, and greater opportunity to implement technological improvements after certification. On the other hand, this approach will reduce the safety and cost benefits of standardization. Although all issues in Tier 1 and Tier 2, the separation by tier, and the test controlling the changes, will be subject to public comment and opportunity for hearing in the certification rulemaking, changes made could be challenged later on the basis that they did not satisfy the Section 50.59-type test. The staff's review of a Level 3 application will be more traditional as directed by the SRP, focusing on that information necessary to make its safety determination. The staff will not request material necessary solely for advancing standardization.

There are three attributes of this approach that bear special attention: (1) it will require substantial amount of design engineering to be completed after certification (This information may be subject to adjudication at some later time as part of a combined license proceeding or later prior to operation (Section 52.103); (2) changes made to the Tier 2 information would be subject to challenge in hearings prior to Commission approval for operation; and (3) there is a potential for customized changes using the Section 50.59-type change mechanism and, therefore, potential for loss of standardization.

LEVEL 4

The degree of standardization resulting from this level of detail and the certification process will provide at least a product line type of standardization.

This degree level of standardization is described here for completeness because it represents a level achieved among a group of four plants that nominally used the same "product" plant design offered by a vendor (i.e., the BWR/6-Mark III combination of nuclear steam supply system and containment). The organizations that joined and set their courses to produce these plants were different for each of the four projects, and GE was the only organization common to all projects. Notwithstanding the fact that these plants are nominally the same "product," they differ in very fundamental characteristics of their designs. The power levels vary among the four plants, but the configuration differences are far greater than the different power levels dictate. Although the design pressure and temperature of the containments were the same for all the plants, completely different construction methods were used, and the containment volumes were all different. Condensate and feedwater systems are markedly different in the numbers of booster and feed pumps, and the combinations of feed pump drives used.

The degree of standardization achieved by the four BWR/6-Mark III plants is less than would be obtained by the least standardization accomplished under Part 52. For that reason, Level 4 is not compared further with Levels 1, 2, and 3.

Coordination: The Office of General Counsel has reviewed this paper and has no legal objection.

Recommendations:

(1) The staff recommends that the Commission provide guidance to the staff regarding the level of detail to be required in an application for design certification and subsequent rule certifying the design under 10 CFR Part 52.

(2) The staff recommends that the Commission provide guidance regarding the two-tiered proposal and the 50.59-type change mechanism described in this paper, and its acceptability as an approach to providing flexibility for a design certification under Part 52.

(3) The staff recommends that the Commission authorize the prompt placement of this paper in the Public Document Room to facilitate the staff discussion of the various options with interested members of the public.

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Enclosure:
Background on Level of Detail

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Friday, August 31, 1990.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Friday, August 17, 1990, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

This paper is tentatively scheduled for discussion at an Open Meeting during the Week of July 16, 1990. Please refer to the appropriate Weekly Commission Schedule for a specific date and time.

SECY understands that the ACRS intends to provide comments following their August 1990 Committee meeting.

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TABLE 1

HVAC SYSTEM AT VARIOUS LEVELS

	1	2	3	4
INFORMATION FOR ALL STRUCTURE/SYSTEMS AND COMPONENTS AFFECTING SAFETY (SCOPE)	A&C	A&C	N	N
INFORMATION FOR SAFETY RELATED AND RISK SIGNIFICANT STRUCTURES/SYSTEMS AND COMPONENTS ONLY (SCOPE)			A&C	A&C
1. DESIGN CRITERIA AND BASES	A&C	A&C	A&C	A&C
2. SYSTEM FUNCTIONAL DESCRIPTION	A&C	A&C	A&C	A&C
3. SYSTEM PERFORMANCE REQUIREMENTS	A&C	A&C	A&C	N
4. FAILURE MODE AND EFFECTS ANALYSES	A&C	A&C	A&C	N
5. SYSTEM P&IDs AND FACILITY LAYOUT DRAWINGS	A&C	A&C	A&C	N
6. ELECTRICAL & I&C SCHEMATICS	A&C	A&C	A&C	N
7. COMPONENT DESCRIPTIONS AND CHARACTERISTICS				
AIR INTAKES (RANGE FOR CAPACITY)	A&C	A&C	A&F	N
FILTERS (RANGE FOR EFFICIENCY/CAPACITY)	A&C	A&C	A&F	N
DUCTS (RANGE FOR SIZE)	A&C	A&C	A&F	N
FANS (RANGE FOR CAPACITY)	A&C	A&C	A&F	N
DAMPERS TYPE (RANGE FOR CLOSURE TIMES)	A&C	A&C	A&F	N
FLOW CONTROL DEVICES (TYPE)	A&C	A&C	A&F	N
AIR CONDITIONING UNITS (RANGE FOR CAPACITY)	A&C	A&C	A&F	N
COOLING COIL TYPE (e.g., CHILLED WATER)	A&C	A&C	N	N
HEATING COIL TYPE (e.g., ELECTRIC)	A&C	A&C	N	N
FAN TYPE (e.g., VANE AXIAL)	A&C	A&C	N	N
FAN DRIVE (e.g., DIRECT)	A&C	A&C	N	N
FILTER TYPE (e.g., CHARCOAL)	A&C	A&C	N	N
CHILLED WATER CIRC. PUMPS (RANGE FOR CAPACITY)	A&C	A&C	N	N
8. PHYSICAL ATTRIBUTES AND CONFIG. OF EACH COMPONENT	A&C	N	N	N
9. GEOMETRIC ASPECTS OF SUSPENDED COMPONENTS	A&C	N	N	N
10. COMPONENT AND STRUCTURAL SUPPORT DATA	A&C	N	N	N
11. AS-PROCURED COMPONENT PERFORMANCE DATA	N	N	N	N

TRADITIONAL REVIEW (SRP)

TRADITIONAL REVIEW (SRP)

A=APPLICATION C= CERTIFICATION F=FLEXIBLE/CHANGE W/O 50.12 N=NOT EXPECTED IN APPLICATION

Enclosure

BACKGROUND ON LEVEL OF DETAIL

Standardization as it exists today ranges from plants that are physically and functionally identical (except for site-related differences) to plants with functionally similar principal components only. The greatest degree of physical and functional standardization, aside from identical units on the same site, is exemplified by the SNUPPS plants--Wolf Creek and Callaway. The degree of standardization achieved by those plants was realized through the specific actions and cooperation of the participating organizations. SNUPPS plants were designed and built by an entity acting as an agent for several utilities. The same architect/engineer (AE) and builder was used, utility input was included in the design, and identical parts were purchased for both plants at the same time--all this contributed to their similarity. Additionally, individual utility preferences were deferred for the sake of standardization. Although identically built, these plants are operated differently, in part because of differences in ultimate heat sink (e.g., Wolf Creek's higher heat rejection capability allows it to operate more efficiently than Callaway).

Strict control over design and construction does not necessarily ensure that features initially standardized will remain constant throughout the life of an operating plant. In order to realize the benefits inherent in the standardization of multiple plants owned and operated by several utilities, those utilities will need continuing mutual agreement to work together to share operating data, evaluate events, plan and execute identical or similar plant modifications, share experience and plans for maintenance and training programs, and even to share costs of identical procurement actions. Upon receiving full-power licenses, the Wolf Creek and Callaway plants began to diverge in design and operating practices. However, recognizing the potential benefits of standardization, the two utilities decided to coordinate many of their activities. Currently, the utilities share the costs of certain major modifications, lessons-learned, and training of outage personnel for specialized outage work.

At the other end of the spectrum, standardization to a point that achieves a functionally similar design is exemplified by the GE BWR/6-Mark III plants. These plants demonstrate a product line type of standardization with only containment, major components, and system functionality standardized. See Attachment I for comparisons between the four BWR/6-Mark III plants. When these plants were built, standardization was not a high-priority objective, but the vendor sold the reactor type and containment general con-figuration as a generic product in large numbers over a short span of time (more than 40 orders within 2 years; domestic and foreign, some of which were canceled). The vendor recognized the benefits of standardization and established programs to guide the company's offering toward a more standardized product at a time when utilities wanted greater power levels. The result of utility management's desires for custom-built features and other market forces was a product line standardization that resulted in four somewhat different domestic BWR/6-Mark III plants: Grand Gulf, Perry, Clinton, and River Bend. For a comparison of standardization as seen today, see Attachment II.

DESIGN DEVELOPMENT

In proceeding toward a license under Part 50, certain traditional factors influenced design development and the level of detail to which that design is taken. NSSS vendors and AEs developed the design to the point that there was reasonable assurance of being able to deliver a product that would perform as specified for a predetermined cost. Design was developed to the extent that a manufacturer could provide equipment to meet performance specifications. The amount of design detail available at any one time during the design/construction process was dependent upon how critical that information was to continuing design/construction in other areas of the plant. Additionally, the utility's contracting preferences and design traditions were accommodated during the design process under Part 50. The FSAR was developed during construction as an output of the design and licensing process, constantly being revised to reflect the progress of design and construction at the facility. At the time of licensing, the FSAR reflected a completed design and contained a considerable amount of as-built detail.

Interviewing various industry representatives revealed the same traditional factors discussed above and some new factors influencing design development and level of detail in an application for a design certification under Part 52. In contrast to the traditional Part 50 design and licensing process in which the FSAR was a product of ongoing design and construction and contained as-built details, under Part 52 the Standard Safety Analysis Report (SSAR) will act as input to the final design document. Potential applicants for design certification are developing their design to the point at which they are confident they can deliver a product suitable for licensing that will perform as specified for a predetermined price. Costs to reach this level are considered reasonable investments by potential applicants. However, there remains a considerable amount of engineering to finalize the design.

COST

In order to gain a perspective on the cost of design certification and degree of engineering completeness, the staff examined the engineering costs and accomplishments associated with various milestones of a recently licensed plant. At this facility, by the time the construction permit was issued, approximately 600,000 man-hours or 4% of the total engineering hours had been expended (42 million 1990 dollars). Approximately 9 million engineering man-hours or 60% of the total engineering hours were expended by the time the FSAR was first docketed (630 million 1990 dollars), and 15.6 million engineering man-hours were required to develop a complete plant (1.092 billion 1990 dollars). "Engineering" as used here, refers to total AE and utility engineering (design and design implementation) to the point of fuel load, not including site and QA/QC engineering.

On the basis of staff discussions with industry representatives, it appears that the prospective applicants for design certification of evolutionary light-water reactors expect certification will require 50% - 60% of all design to be complete for a cost of $150 million - $350 million. Certain applicants believe that they currently have or will have more engineering completed than is necessary to support certification. This appears to vary with the amount of outside participation the applicant has been able to attract. Certain prospective applicants have designs under way for evolutionary LWRs to be built overseas that afford them the AE and utility funding to develop more design detail based on a complete design on a specific site. Some of the applicants have entered into joint ventures with AEs to provide engineering design.

One of the prospective applicants now developing an advanced design for certification expects completion of certification will require approximately 40% of design engineering to be completed for a cost of about $135 million. This applicant also expects utility participation approximately two years before the design is certified.

It should be noted in considering the percentage of engineering complete, the industry believes a large portion of the safety-significant engineering associated with the design will be completed earlier under Part 52 than in the traditional Part 50 process. Although a considerable amount of detailed engineering design will remain to be translated into specifications and construction drawings after design certification, more design information will be developed and translated into engineering drawings, specifications, and analysis at the time of certification, than is now in a first-docketed FSAR under the Part 50 process.

ITAAC

Inspections, tests, analyses, and acceptance criteria (ITAAC) must be developed by the applicant and submitted for staff review as specified in Section 52.47(a)(1)(vi). ITAAC will provide reasonable assurance that a plant which references the design is built and will operate in accordance with the design certification.

Under Appendix B to Part 50, which is invoked by Part 52, design and construction attributes will be verified by various processes. The design of the facility will be validated by the design and document control process, procurement and construction verification will be performed as part of the applicant's construction quality assurance/quality control program, system performance will be verified through preoperational and start-up tests, and deviations between the as-designed and as-built facility will be evaluated and dispositioned through the design reconciliation and corrective action process. What is unique to the Part 52 process is the preconstruction identification of key elements of these programs that, in the past, evolved during the course of construction.

As defined in Part 52, the ITAAC must be necessary and sufficient to provide reasonable assurance that a plant that references the design is built and will operate in accordance with the design certification. Depending on how the terms "reasonable assurance" and "necessary and sufficient" are interpreted, the ITAAC scope can range from the verification of every design and construction attribute included in the design certification to verification of directly measurable process parameters (e.g., flow, temperature, pressure, voltage, current) that demonstrate system performance/functionality. For the Level 1 option, the ITAAC at one end of the spectrum, could be very detailed, since they may entail verification of a large number of design and construction attributes.

Given that ITAAC will functionally duplicate other programs that verify hundreds if not thousands of design and construction attributes, the scope of ITAAC can be restricted to a set of principal attributes that are necessary and sufficient to provide reasonable assurance at the design certification stage that the plant will be built and will operate consistent with the design certification. It is the staff's view that the ITAAC were not meant to be a one-for-one check of detailed design and construction attributes (e.g., the embedment length of anchor bolts) that are verified in the quality programs already in place.

Basically, there are two types of ITAAC. The first includes direct verification of performance and construction attributes through field inspections, measurements, and tests; for example, pump operability tests including pump flow and discharge pressure measurements. The second type validates performance and functional requirements that do not lend themselves to direct measurements; for example, the validation of containment performance analyses results (e.g., maximum temperature and pressure under postulated accident conditions) by direct measurement of analyses assumptions, such as containment net-free volume. As the level of detail available at design certification becomes more specific (i.e., standardization at Level 1), the ITAAC can, to a greater degree, call for verification of a greater number of specific numerical values of design and construction attributes, since these would be available. The proportion of named attributes for which quantitative values could be identified will be less at Levels 2 and 3. However, as discussed above, the ITAAC for Levels 1, 2, or 3 can contain the same attributes to be verified. For all three levels, actual values determined during the post combined operating license (COL) construction period would be reconciled with system design requirements through ITAAC at the post COL stage.

ITAAC at the most detailed level will not provide additional verification of design or construction beyond that achieved in the construction phase of a project licensed under Part 50. However, an adjunct and important function of the ITAAC is to ensure, at the design certification stage, the integrity and credibility of a one-step licensing process.

The ITAAC becomes an early, binding commitment to elements of existing quality programs and serves as an independent final check, similar to the independent design verification programs (IDVPs) and readiness reviews that were conducted on recent operating license applications. The ITAAC, like the IDVPs and readiness reviews provide additional assurance that the design and construction processes and the quality programs functioned adequately. From this approach to ITAAC, several objectives are attained: (1) reasonable assurance is provided at the design certification stage that design and construction processes will be conducted and the plant will operate in accordance with the certification; (2) during and following construction, the principal performance criteria specified in the ITAAC will provide highly visible checkpoints for measuring and ensuring the as-built facility is in accordance with the certified design; (3) through a progressive and sequential implementation of the ITAAC, problems will be promptly identified and addressed; and (4) throughout the plant's operating life, the ITAAC will ensure the design remains consistent with the certification.

ATTACHMENT I

BWR/6-MARK III

The BWR 6/Mark III plants that are compared on the chart are in many areas similar with a pattern of differences due to an increase in power output on later models. Examples are noted below for each of the areas on the comparison charts.

Reactor Vessel and Internals:
Clinton and River Bend are virtually identical. Perry and Grand Gulf are notably larger and higher rated. Void coefficients, fuel temperature, doppler, minimum critical power ratio, initial U-235 enrichment, etc. are slightly different.

	diam.	Thick	Height	Rating
Clinton	18'2"	5.3"	69"	2894 MWt
River Bend	18'2"	5.3"	69"	2894 MWt
Perry	19'10	6.0"	70"	3579 MWt
Grand Gulf	20'11	6.14"	73"	3833 MWt

Fuel/Control Rods:
Although the fuel elements and control rods are similar, the same pattern of increasing quantity is evident.

	Fuel Assemblies	Control Rods	LPRMs
Clinton	624	145	132
River Bend	592	145	132
Perry	748	177	164
Grand Gulf	800	193	176

ATTACHMENT I

BWR/6-MARK III

Reactor Coolant System:
Similar with the same increase pattern.

	# Jet Pumps	Recirc Pump Flow (gpm)
Clinton	20	32,500
River Bend	20	32,500
Perry	20	42,000
Grand Gulf	24	44,900

Main Steam:
Only noted difference was an increase in pipe diameter.

Clinton	24"
River Bend	24"
Perry	26"
Grand Gulf	28"

Condensate and Feedwater:
The differences in the design of these were more significant than the previous areas as noted below.

	# Cond. Pumps	#Cond. Booster	# Feed. Pumps	Feed Pump Drive Types
Clinton	4	4	3	2 Turbine/1 Motor
River Bend	3	0	3	All Motor
Perry	3	3	3	2 Turbine/1 Motor
Grand Gulf	3	3	2	Both Turbine

ATTACHMENT I

BWR/6-MARK III

Containment:

Although the design pressure and temperature were the same for all four plants, the style of construction varied significantly.

Clinton	Reinforced concrete cylindrical structure with hemispherical dome, steel lined, enclosing drywell and suppression pool.
River Bend	Cylindrical freestanding steel with ellipsoidal head.
Perry	Cylindrical freestanding steel with ellipsoidal head with reinforced concrete shield building.
Grand Gulf	Similar to Clinton

	Leak Rate (%/day)	Volume (E6 ft3)
Clinton	0.65	1.55
River Bend	0.26	1.19
Perry	0.20	1.14
Grand Gulf	0.35	1.4

Reactor Protection System:

Clinton is significantly different from the others since they have the solid state reactor protection system.

ATTACHMENT I

BWR/6-MARK III

Radwaste System: Gaseous

	Process Treatment	# Beds	Release point
Clinton	Chilled charcoal	2	199.5'
River Bend	Chilled charcoal	8	190'
Perry	Recombiner & chilled charcoal	8	134'
Grand Gulf	Chilled Charcoal	8	31.5'

Eletrical systems:

	Clinton	River Bend	Perry	Grand Gulf
# Offsite Circuits	4(1 units)	6(2 units)	5	3(1 unit) 4(2 units)
# Aux Power Sources	2 Aux, 1 Rsrv Aux 1 Emerg.	4 Unit Aux. 4 Rsrv Aux.	4 Unit Aux 1 Startup/ Unit	3 Service 1 for ESF
# Preferred Pwr to ESF Buses	2	2	2	3
# ESF Buses	3	3	3	3
# Stby A-C Pwr Supplies	3 (1/ESF)	6 (1/ESF)	6 (1/ESF)	6 (1/ESF)
# 125 V DC Systems	3	6	6	6

ATTACHMENT I

BWR/6-MARK III

Safety Systems:

ECCS are similar in design but again sized up.

	LPCS(gpm)	HPCS(gpm)	RCIC(gpm)	ADS	Total SRVs
Clinton	5010	1400	600	7	16
River Bend	5010	1400	600	7	19
Perry	6000	1550	700	8	19
Grand Gulf	7115	1650	800	8	20

Residual Heat Removal	# Pumps	LPCI (gpm/pump)
Clinton	2	5050
River Bend	2	5050
Perry	2	6500
Grand Gulf	4	7450

Emergency Service Water System:

Design of load allocation varied significantly from plant to plant resulting in a significant difference in ESWS flows.

Clinton	34,100 gpm
River Bend	34,100 gpm
Perry	22,700 gpm
Grand Gulf	25,300 gpm

ATTACHMENT I

BWR/6-MARK III

Ultimate Heat Sink:

Varied based on location.

		# Circ. Water Pumps
Clinton	Lake	3
River Bend	River	4
Perry	Lake Erie	3
Grand Gulf	River	2

Seismic/Structural Design:

	Clinton	River Bend	Perry	Grand Gulf
SSE horiz. g	0.25	0.10	0.15	0.15
vert. g	0.25	0.10	0.15	0.10
OBE horiz. g	0.10	-	0.075	0.075
vert. g	0.10	-	0.075	0.050
Wind Speed (mph)	85	100	90	90
Tornados (mph)				
Transl.	70	70	70	60
Tangen.	290	290	290	300

Technical Specifications:

All TS are unique hybrids incorporating BWR standard TS and plant specific designs.

ATTACHMENT II

STANDARDIZATION SEEN TODAY

SYSTEM DESCRIPTION	SNUPPS Wolf Creek Callaway	BYRON/BRAIDWOOD	BWR/6-MARK III Grand Gulf Perry Clinton River Bend
Reactor Vessel and Internals	I	I	S
Fuel/Control Rods	I	I	C,RB:S GG,P:D
Reactor Coolant System incl. Major Components Pumps/Valves/SG	I	I	C,RB:I GG,P:S
Main Steam	I	I	C,RB:I GG,P:S
Condensate and Feedwater	I	I	D
Main Turbine and Control Valves	I	I	D
Containment and Major Components	I	I	GG,C:S P,RB:S

ATTACHMENT II

STANDARDIZATION SEEN TODAY

SYSTEM DESCRIPTION	SNUPPS Wolf Creek Callaway	BYRON/BRAIDWOOD	BWR/6-MARK III Grand Gulf Perry Clinton River Bend
Reactor Protection System	I	I	RB,GG,P:S C:D
Radwaste System	I	I	C,RB:S GG,P:D
Electrical System	S (diff. lines)	S (diff. lines)	D
AC/DC Onsite	I	I	RB,P,GG:S C:D
Safety Systems			
ECCS	I	I	C,RB:I GG,P:S
SLIC/RCIC	NA	NA	C,RB:I GG,P:S
AFW	I	I	NA
RHR System	I	I	C,RB:I GG,P:S

ATTACHMENT II

STANDARDIZATION SEEN TODAY

SYSTEM DESCRIPTION	SNUPPS Wolf Creek Callaway	BYRON/BRAIDWOOD	BWR/6-MARK III Grand Gulf Perry Clinton River Bend
Process Control			
Turbine	I	I	D
Feedwater	I	I	D
Control Rods	I	I	S
Service Water Systems	D	D	D
Component Cooling Water	D	D	D
Ultimate Heat Sink	D	D	D

C = Clinton
RB = River Bend
GG = Grand Gulf
P = Perry

I = Identical
S = Similar
D = Different

ATTACHMENT II

STANDARDIZATION SEEN TODAY

SYSTEM DESCRIPTION	SNUPPS	BYRON/BRAIDWOOD	BWR/6-MARK III
	Wolf Creek	Byron	Grand Gulf
NSSS	W	W	GE
AE	Bech	S&L	Bech
CONST	Dani	CWE	
	Callaway	Braidwood	Perry
	W	W	GE
	Bech	S&L	Gil
	Dani	CWE	Kais
			Clinton
			GE
			S&L
			Bald
			River Bend
			GE
			S&W
			S&W

GE: General Electric
W: Westinghouse
Bald: Baldwin Associates
Bech: Bechtel
CWE: Commonwealth Edison
Dani: Daniel International
S&L: Sargent and Lundy
S&W: Stone and Webster