PUBLIC SERVICE INDIANA
MARBLE HILL NUCLEAR GENERATING STATION
UNITS 1 & 2
PROJECT NO'S. 4808/4923

Classification Criteria of Structures, Systems and Components

CC-ME-01-MH

12/27/74 Date

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CLASSIFICATION CRITERIA OF STRUCTURES, SYSTEMS AND COMPONENTS

1.0 SCOPE - The purpose of this Criteria is to establish the scheme by which structures, systems and components are classified in relation to their importance to safety. This Criteria also sets the general classification of the major structures, systems and components and is to be used as the basis for establishing the more detailed classification required in project documents such as Design Criteria, PSAR, Equipment, Valve and Piping Lists and Cable Tabulation.

2.0 REFERENCES

2.1 Appendix A, 10 CFR 50
2.2 Regulatory Guide 1.29
2.3 Appendix B, 10 CFR 50
2.4 Regulatory Guide 1.26
2.5 Byron/Braidwood PSAR, Chapter 3
2.6 Regulatory Guide 1.32 (August, 1972) and IEEE standard 308-1971
2.7 RESAR, Chapter 3
2.8 DC-RN-01-MH, Design Criteria for Replication

3.0 DEFINITIONS

3.1 Safety Classification - Structures, systems and components are classified for design purposes as either Safety Category I or Safety Category II. Systems and Components are further classified by the appropriate Quality Group (See 3.4 below) or Class 1E designation (See 3.5 below) as applicable. The safety classification of Duplicate Features is identical to that of the Base Plant as defined in Reference 2.8.

3.2 Safety Category I structures, systems, and components are those necessary to assure: (a) the integrity of the reactor coolant pressure boundary, (b) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (c) the capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures comparable to the guideline exposures of 10 CFR 100, in the postulated events of the safe shutdown earthquake (SSE) and other design basis events including tornado, probable maximum flood, operating basis earthquake (OBE), missile impact, or accident internal to the plant.

3.3 Safety Category II - Those structures, systems, and components which are not designated as Safety Category I are designated as Safety Category II. This category has no public health or safety implication.

3.4 Quality Group Classification - The quality group classification system defined in Regulatory Guide 1.26 (Ref. 2.4), established for water, steam, or radioactive material - containing components important to safety, is directly applicable.

3.5 Class 1E - Electric Systems - The systems that provide the electric power used to shut down the reactor and limit the release of radioactive material following a design basis event.

3.6 Single Failure - A single failure is an occurrence which results in the loss of capability of a component to perform its intended safety functions when called upon. Multiple failures resulting from a single occurrence are considered to be a single failure. Fluid and electrical systems are considered to be designed against an assumed single failure if neither (1) a single failure of any active component (assuming passive components function properly); nor (2) a single failure of a passive component (assuming active components function properly) results in a loss of the safety function to the nuclear steam electric generating unit.

3.7 Active Failure - An active failure is the failure of a powered component such as a piece of mechanical equipment, component of the electrical supply system or instrumentation and control equipment to act on command to perform its design function. (Ref. 2.7)

3.8 Passive Failure - A passive failure is the structural failure of a static component which limits the component's effectiveness in carrying out its design function. (Ref. 2.7)

3.9 Design Basis Event - A design basis event is a natural phenomenon or failure of a system, component or structure which is postulated to provide the basis for designing the safety-related aspects of the plant. Examples are safe shutdown earthquake (SSE), wind and tornadoes, probable maximum flood, missiles and loss of coolant accident (LOCA).

4.0 FUNCTIONAL REQUIREMENTS

4.1 Safety Category I structures, systems and components shall perform their intended safety functions in the event of the safe shutdown earthquake (SSE) and other design basis events.

4.2 Safety Category I structures, systems and components shall retain their own integrity and/or shall not constitute a hazard to other Safety Category I structures, systems or components during the safe shutdown earthquake and other design basis events.

4.3 Safety Category I systems and components shall perform their intended safety functions assuming a single failure and loss of off-site power.

4.4 The plant design shall ensure that Safety Category II structures, systems or components do not constitute a hazard to Safety Category I structures, systems or components during the safe shutdown earthquake and other design basis events.

5.0 DESIGN REQUIREMENTS

5.1 Safety Category I systems and components shall not be located in Safety Category II structures.

5.2 Systems or portions of systems which are designated Safety Category I shall be identified as appropriate in the various design documents associated with that system.

5.3 The division between Safety Category I and II portions of systems shall be in accordance with the intent of Regulatory Guide 1.29. The seismic design of Safety Category I items is in accordance with the requirements of Regulatory Guide 1.29.

5.4 Quality Assurance Requirements for Safety Category I systems or portions of systems and components shall meet the requirements of Appendix B to 10 CFR 50.

5.5 Safety Category II structures, systems and components need not be specifically designed for dynamic operating-basis-earthquake loadings; however, a reasonable margin of safety shall be considered in the design as dictated by local requirements, such as the Uniform Building Code.

5.6 Safety Category II systems or portions of systems and components need not follow the requirements of Appendix B to 10 CFR 50; however, the Quality Assurance standards for these systems and components shall follow normal industrial standards and any other requirements deemed necessary by the owner.

6.0 SAFETY CLASSIFICATION

6.1 Table 1 indicates the overall correspondence between safety categories and Quality Groups and the general boundaries of systems to be considered part of each quality group.

R 6.2 Table 2 lists all major plant structures and components which shall be designated as Safety Category I and their respective Quality Group/Electrical classifications. Table 2 also lists the major plant structures and several components which shall be designated as Safety Category II. The safety classification of all piping, valves and instrumentation within each system in Table 2 is not feasible within this classification criteria document. The Scope section of this document references sources containing detailed classifications of piping, valves and instrumentation.

6.3 Table 3 identifies the applicable codes and standards to be used for each quality group.

6.4 Table 4 gives a cross-reference which can be used to translate from the Westinghouse (RESAR or ANS) safety classification system to the classification system established in this document when utilizing more detailed Westinghouse documents such as the NSSS Systems Standard Design Criteria.

7.0 TABLES

TABLE 1. Relation Between Quality Group and Safety Category Classifications

QUALITY GROUP	SAFETY CATEGORY	GENERAL SYSTEM DESCRIPTION
A	I	Reactor coolant pressure boundary and extensions thereof
B	I	Emergency core cooling, post-LOCA heat removal and cleanup, safe reactor shutdown and heat removal, portions of main steam and feedwater associated with containment isolation
C	I	Systems required to support those in Quality Group B, spent fuel cooling, radioactive waste systems which normally contain a high level of radioactive material
C	II	Parts or portions of systems which contain or may contain radioactive material, which have been upgraded to Quality Group C to meet NRC requirements
D	II	Parts or portions of systems which contain or may contain radioactive material

TABLE 2

SAFETY CLASSIFICATION OF STRUCTURES, SYSTEMS AND COMPONENTS

	COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
	Reactor Coolant System		
	Reactor Vessel	A	I
	Steam Generator		
	Tube Side	A	I
R	Shell Side	B	I
	Reactor Coolant Loop Stop Valves	A	I
	Pressurizer	A	I
	Pressurizer Relief Tank	D	II
	Reactor Coolant Pumps	A	I
R	Motors	-	II
	Chemical And Volume Control System		
	Regenerative Heat Exchangers	B	I
	Letdown Heat Exchangers		
	Tube Side	B	I
	Shell Side	C	I
	Seal Water Heat Exchangers		
	Tube Side	B	I
	Shell Side	C	I
	Excess Letdown Heat Exchangers		
	Tube Side	B	I
	Shell Side	C	I
	Volume Control Tank	B	I
	Reciprocating Charging Pumps	B	I
	Centrifugal Charging Pumps	B	I
	Mixed Bed Demineralizers	C	I

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Cation Bed Demineralizers	C	I
Resin Fill Tank	D	II
Chemical Mixing Tank	D	II
Moderating Heat Exchanger		
Tube Side	C	I
Shell Side	C	I
Letdown Chiller Heat Exchanger		
Tube Side	C	I
Shell Side	D	II
Chiller Pumps	D	II
Chiller Surge Tank	D	II
Letdown Reheat Heat Exchanger		
Tube Side	B	I
Shell Side	C	I
Thermal Regeneration Demineralizers	C	I
Boric Acid Tanks	C	I
Boric Acid Batching Tank	D	II
Boric Acid Transfer Pumps	C	I
Reactor Coolant Filter	B	I
Seal Water Injection Filter	B	I
Seal Water Return Filter	B	I
Boric Acid Filter	C	I
Boric Acid Blender	C	I

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Boron Recycle System		
Recycle Evaporator Feed Demineralizers	C	I
Recycle Hold-Up Tanks	C	I
Recycle Evaporator Feed Pumps	C	I
Recycle Evaporator	C*	I
Recycle Monitor Tanks	D	II
Monitor Tank Pumps	D	II
Recycle Evaporator Condensate Demineralizer	D	II
Recycle Evaporator Feed Filter	C	I
Recycle Evaporator Concentrates Filter	D	II
Recycle Evaporator Condensate Filter	D	II
Reactor Makeup Water Storage Tank	D	II**
Safety Injection System		
Refueling Water Storage Tank	B	I
Accumulators	B	I
Boron Injection Tank	B	I
Safety Injection Pumps	B	I
Boron Injection Surge Tank	C	I
Boron Injection Recirculation Pumps	C	I

* The steam side of the evaporator is Quality Group D. Only those portions containing radioactive liquid are designated I-C.

** Designed to Safety Category I seismic requirements.

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Residual Heat Removal System		
Residual Heat Removal Pumps	B	I
Residual Heat Exchangers		
Tube Side	B	I
Shell Side	C	I
Containment Spray System		
Containment Spray Pumps	B	I
Spray Additive Tanks	B	I
Spray Eductors	B	I
Component Cooling System		
Component Cooling Heat Exchangers	C	I
Component Cooling Pumps	C	I
Component Cooling Surge Tanks	C	I
Essential Service Water System		
Essential Service Water Pumps	C	I
Essential Service Water Strainers	C	I
R		
Spent Fuel Pit Cooling System		
Spent Fuel Pit Heat Exchanger	C	I
Spent Fuel Pit Pump	C	I
Skimmer Pump	D	II
Spent Fuel Pit Filter	D	II

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Spent Fuel Pit Cooling System (Continued)		
Spent Fuel Pit Demineralizer	D	II
Refueling Water Purification Pump	C	I
R Motor	-	II
Reactor Coolant Drain System		
Reactor Coolant Drain Tank	D	II
Reactor Coolant Drain Pumps	D	II
Gaseous Radwaste System		
Waste Gas Compressor	C	I
Gas Decay Tanks	C	I
Gas Analyzer	C	II
Nuclear Sampling System		
Sample Heat Exchanger		
Tube Side	C	I
Shell Side	C	I
Auxiliary Feedwater System		
Auxiliary Feedwater Pumps	C	I
R Auxiliary Feedwater Pump Diesels	-	I
Diesel Oil System		
Diesel Oil Storage Tanks	C	I
Diesel Oil Transfer Pumps	C	I

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Liquid Radwaste System		
Blowdown Condenser	D	II
Blowdown Condenser Pump	D	II
Blowdown Demineralizers	D	II
Blowdown Prefilters	D	II
Blowdown Monitor Tanks	D	II
Blowdown Monitor Tank Pumps	D	II
Blowdown Evaporator	D	II
Auxiliary Building Floor and Equipment Drain Tanks	D	II
Turbine Building Floor and Equipment Drain Tanks	D	II
Spent Resin Storage Tank	C	I
Liquid Radwaste Pumps	D	II
Laundry Drain Tanks	D	II
Release Tank	D	II
Liquid Radwaste Filters	D	II
Radwaste Evaporator	D	II
Waste Evaporator Monitor Tanks	D	II
Chemical Drain Tank	D	II

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Instrument Air System		
Instrument Air Compressors	-	II
Instrument Air Receivers	-	II
R Instrument Air Afterfilters	-	II
Instrument Air Dryers	-	II
Instrument Air Prefilters	-	II
Containment Ventilation and Purge System		
Reactor Containment Fan Coolers	NA*	I
Hydrogen Recombiners	NA*	I
Control Room HVAC System		
Makeup, Supply and Return Fans and Motors	-	I
R Cooling Coils	C	I
Filters	-	I
Fire Protection System		
Centrifugal Pumps	D	II
Piping		
R Turbine Building	D	II
Auxiliary Building	C	I

* Quality measures equivalent in intent to those in Quality Group B will be applied.

** Quality measures equivalent in intent to those in Quality Group C will be applied.

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Main Steam and Feedwater Systems		
Piping from Steam Generators Out to and Including First Stop Valves Outside Containment	B	I
R Main Steam Safety Valves	B	I
Main Steam Relief Valves	B	I
Miscellaneous Components		
New Fuel Storage Racks	NA**	I
Spent Fuel Storage Racks	NA**	I
Containment Building Crane	NA**	I
Fuel Handling Building Crane	NA**	I

** Quality measures equivalent in intent to those in Quality Group C will be applied.

TABLE 2 (Continued)

COMPONENT	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Engineered Safety Features (ESF) Electrical Components		
4160 V ESF Buses	1E***	I
480 V ESF Buses	1E***	I
Diesel Generators, ESF	1E***	I
125V d-c Buses, ESF	1E***	I
125V d-c Batteries & Chargers, ESF	1E***	I
120V a-c Instrument Buses, ESF	1E***	I
120V a-c Inverters, ESF	1E***	I
480V a-c Motor Control Centers fed from 480 V ESF Buses	1E***	I
Electrical Penetrations	1E***	I
Containment Cooling Fan Motors	1E***	I
Auxiliary Feedwater Pump Motors	1E***	I
Containment Spray Pump Motors	1E***	I
Essential Cooling Tower Fan Motors	1E***	I
Centrifugal Charging Pump Motors	1E***	I
Residual Heat Removal Pump Motors	1E***	I
Safety Injection Pump Motors	1E***	I
Essential Service Water Pump Motors	1E***	I

*** Electrical Class per IEEE-308 endorsed in RG-1.32.

TABLE 2 (Continued)

COMPONENTS	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
Engineered Safety Features (ESF) Electrical Components (Continued)		
Component Cooling Pump Motors	1E***	I
Diesel Generator Room Fan Motors	1E***	I
Interconnecting cables between Safety Category I Electrical Equipment	1E***	I
Non-ESF Electrical Systems and Components	----	II
STRUCTURES		
Solid Radwaste Storage Building	NA	II
Service Building	NA	II
Essential Service Cooling Towers & Basins	NA	I
Circulating Water Cooling Towers	NA	II
R Circulating Water Pumphouses	NA	II
Main Steam Tunnels	NA	I
Auxiliary Feedwater Tunnels	NA	I
River Pumphouse	NA	II
R Reactor Containment Structures	NA	I
Auxiliary Building	NA	I
Fuel Handling Building	NA	I
Turbine Building	NA	II

*** Electrical Class per IEEE-308 endorsed in RG-1.32.

TABLE 2 (Continued)

COMPONENTS	QUALITY GROUP or ELECTRICAL CLASS	SAFETY CATEGORY
R Blowdown Discharge Structure	NA	II
Switchyard Structures	NA	II
Water Well Structures	NA	II
All Site Development Civil Works	NA	II

TABLE 3

CODE REQUIREMENTS FOR COMPONENTS AND SYSTEMS

COMPONENT OR SYSTEM	QUALITY GROUP A(3)	B(3)	C(3)	D
Pressure Vessels	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 1	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 - 1974
Piping	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 1	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	ANSI B31.1.0 - 1973, Code for Pressure Piping
Pumps and Valves	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 1	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	ANSI B31.1.0 - 1973(2), Code for Pressure Piping
Low-Pressure Tanks	—	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	American Petroleum Institute, Recommended Rules for Design and Construction of Large Welded Low-Pressure Storage Tanks, API 620, 1973 edition
Atmospheric Storage Tanks	—	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	American Waterworks Association, Standard for Steel Tanks, Standpipes, Reservoirs and Elevated tanks for Water Storage, AWWA-D100, 1973 edition; or Welded Steel Tanks for Oil Storage, API-650, 1973 edition, or ANSI B96.1, 1973 edition for aluminum tanks
Heat Exchangers	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 1	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 2	ASME Boiler and Pressure Vessel Code, Section III - 1974, Class 3	ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 - 1974; and Tubular Exchanger Manufacturers Association (TEMA) Class C

(1) Containment vessel excluded

(2) For pumps operating above 150 psi and 212°F, ASME Section VIII, Div. 1, shall be used as a guide for calculating thickness of pressure retaining parts and in sizing cover bolting; below 150 psi and 212°F, manufacturer's standards for service intended will be used.

(3) Code and addenda dates per 10 CFR 50.55a

TABLE 4

CROSS REFERENCE FROM WESTINGHOUSE RESAR (ANS) SYSTEM OF SAFETY CLASSIFICATION TO MARBLE HILL SAFETY CLASSIFICATION SYSTEM*

WESTINGHOUSE RESAR-3 (ANS)	MARBLE HILL	
	QUALITY GROUP	SAFETY CATEGORY
1	A	I
2	B	I
3	C	I
NNS	D	II

* The following exceptions to the above cross-reference are noted; in these cases the Marble Hill Safety Classification is to be used: Refueling Water Purification Pump, Spray Additive Tanks, Excess Letdown Heat Exchangers - Shell Side.

Draft Working Paper

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Notes from Marble Hill Case Study

II. A. What Happened at Marble Hill

In April 1978, NRC issued to PSI construction permits for the construction of two 1150 Mw Westinghouse four loop PWRs at the Marble Hill site near New Washington, Indiana. PSI had announced construction of the units in November 1973 and applied for a CP in July 1975. A limited work authorization was granted in __________ 1977, and PSI acted as general contractor for the project, which was the first nuclear project undertaken by the utility. Sargent and Lundy was retained as architect/engineer. The Newberg Construction Company, which had participated in the construction of a number of fossil-fired plants for PSI in the past, was retained as the civil contractor for the Marble Hill Nuclear Station. Subsequent paragraphs describe the problems of quality in construction that developed at Marble Hill. This material is excerpted from testimony delivered by J. J. Harrison, NRC Senior Resident Inspector at Marble Hill, to Congressional aides in February of 1982.

NRC inspections of concrete work underway in April and May, 1979, identified deficiencies in the control of quality during concrete placement at Marble Hill. In a meeting with Region III on May 15, Public Service of Indiana (PSI) agreed to upgrade its quality assurance program for the concrete work and to determine through testing if previously poured concrete was adequate.

In June a former site employee alleged that surface defects in the concrete had been improperly patched, and in July the National Board of Boiler and Pressure Vessel Inspectors identified code-compliance problems with piping installation.

Concrete work was halted June 26 at the request of Region III; then briefly resumed in July before all safety-related construction work was halted August 7, 1979, by PSI after NRC inspectors determined there was significant questions concerning PSI's quality assurance program and its construction management.

These findings were based on NRC inspections of concrete placement, repairs and testing procedures, on the confirmation of allegations by construction workers at the site, and on the finding of the National Board of Boiler and Pressure Vessel Inspectors.

A confirmation order was issued by the NRC staff on August 15, 1979.

A full time NRC Resident Inspector was assigned to Marble Hill on December 3, 1979.

After numerous meetings with the NRC, PSI submitted on February 28, 1980, its formal reply to the order, detailing its effort to upgrade and implement its revised QA program.

One month later, on March 25, 1980, a public meeting on the proposed corrective action was held by the NRC before some 500 local residents in Madison, Indiana.

To assure that PSI's corrective actions were properly and effectively implemented, the Commission approved a five-step plan for gradual recission of the order. The five stages would be subject to intensive reviews by NRC inspectors with an NRC "hold point" at each stage before the next could be undertaken. Additionally, there were intermediate "hold points" within each stage.

The plan covered: (1) Revised Quality Assurance Program; (2) Receipt Inspections; (3) Material Verification Program; (4) Construction Verification Program; (5) Resumption of Constuction.

One major concern of the NRC's was the apparent low number of qualified QA and management personnel at the site. This concern was addressed by the licensee with an accelerated hiring and training program and a shifting of personnel to the plant site. Currently the entire Nuclear Division is at the site.

Two independent outside consultants were also retained by the NRC to provide an independent analysis of the concrete work, which had been requested by Save-the-Valley a Madison, Indiana, public interest group. A third engineer, representing Save-the-Valley accompanied the NRC consultants during their review at the site.

After PSI restructured its QA and Construction Management Programs, it was permitted on July 7, 1980, to resume receipt inspections of materials at the construction site, and later contractors were also permitted to undertake receipt inspections.

On December 5, 1980, the NRC permitted limited electrical work and pipe installation to resume by Cherne Contracting Co., the piping contractor, and Commonwealth Lord, the electrical contractor. Then on March 27, 1981, PSI was authorized to resume all remaining safety-related work, including concrete placement. Unrestricted authority to continue the work would not be granted until the utility successfully demonstrated that its quality assurance and construction management programs were implemented properly.

The additional work authorizatrion included concrete repair and placement, structural steel installation and protective coatings. In addition to new concrete work, PSI contractors began removing and replacing <u>all</u> patches previously made to repair surface defects in the concrete, about 6,400. As of February 13, 1982, the patching program is about 82 percent completed.

An NRC review of tests and examinations concluded that the existing in-place concrete work was structurally sound. This determination was based, among other things, on tests performed by PSI contractors and observed by NRC personnel.

The NRC's independent consultants also concluded that the quality of the concrete at Marble Hill was acceptable.

B. Marble Hill Today

In an October 26, 1981 inspection report on Marble Hill, Region III inspectors stated in item 12, "Summary Findings of This Special Inspection: It is Region III's conclusion that PSI has adequately implemented its commitments made in response to the August 15, 1979, Order Conforming Suspension of Construction and the related conventions and agreements in accordance with the NRC's document entitled Graduated Recission of Order August 15, 1979."

On February 12, 1982, following a site visit by NRC management, the 'Confirming Order" was lifted, thus enabling construction to continue with no restrictions.

Note: Region III has rated the Marble Hill QA program "outstanding" in the last two SALP reports.

III. Root Causes of Marble Hill's Problems with Quality in Construction

Based on our review of NRC and other documentation regarding the Marble Hill case and our discussions with cognizant NRC, licensee, and contractors staff, the following appear to be the primary and secondary root causes of the quality problems that manifested themselves in 1979 and led to the cessation of safety-related work at the project.

A. Primary Root Cause

The primary root cause of PSI's problems at Marble Hill was their lack of experience in building a nuclear project. They simply did not understand or fully appreciate the several quantum jumps of complexity difference between building fossil plants and building

nuclear plants. Their experience in building fossil plants had been quite positive: they had built nearly a score of successful fossil plants in the past thirty years, generally completing the projects on schedule (or before) and within budget. This led to the development of a mind set sometimes referred to as a "fossil mentality" - the feeling that building a nuclear plant could not be much more difficult than building a fossil plant, the main difference being in how the steam was generated.

Their inexperience with nuclear projects, their failure to appreciate the legal and engineering complexity of a nuclear project, and their overall fossil-oriented outlook manifested itself in the manner in which they addressed the project, resulting in several managerial errors which ultimately led to the stoppage of safety-related work. Primary among these errors was a failure to staff the nuclear project adequately with sufficient personnel having applicable nuclear-related experience. They did staff a few key positions with personnel who had good nuclear credentials, but their procurement of personnel with appropriate nuclear experience was of neither sufficient breadth nor depth to provide reasonable assurance of success.

Another error lay in their understanding, or perhaps misunderstanding, of NRC and its role in the licensing and oversight of nuclear construction projects. With their strictly fossil background, they tended to view NRC as another government agency with another set of regulatory hurdles to engage and complete, much like an EPA or an

OSHA. This lack of understanding of NRC contributed in part to their failure to recognize the extent of their problems earlier than they did - they heard what NRC said but they were not really listening (NRC is not above reproach either as will be described later).

Another management error on PSI's part was their over reliance on contractors. They tended to view their contractors as the experts in the areas in which they were working and generally not to question their activities. Moreover, they turned over defacto management of the project to their contractors. (More about this later.)

Similar to their lack of understanding of the importance of NRC and its rules, was a lack of understanding of the importance of various ASME and other codes. This misunderstanding caused them to be slow to recognize the importance or significance of the July 1979 findings of the National Board of Boiler and Pressure Vessel Inspectors referred to in the excerpt from Mr. Harrison's testimony.

Finally, their inexperience (and over reliance on contractors) resulted in their not recognizing or being able to recognize that the symptoms of construction quality problems they saw with the honeycombing of the concrete and improper patching were indications of a much deeper underlying mailiase in their entire program of project and quality management. In short, they saw the symptoms but did not understand nearly how much deeper the underlying causes ran.

B. Secondary Root Causes

Based on our reading, discussions, and analysis, we have identified four secondary root causes of the construction problems experienced at Marble Hill in 1979. They are:

1. lack of understanding of the potential merit of a formal program for quality,

2. development of a false sense of security by PSI,

3. failure of PSI to manage the Marble Hill project from the outset, and

4. NRC licensing, inspection, and enforcement practices.

We will explain each of these in more detail.

1. Lack of understanding of the potential merit of a formal program for quality.

   As indicated above, PSI has a history of completing successful fossil projects on time and within budget. PSI viewed quality in such a project as something that just gets built in - it comes naturally as the result of good management and an able, knowledgeable, and dedicated staff. Everyone from the top down

knows what it takes to build a successful fossil plant, and they all work together to ensure that the overall project and final project works and is safe. PSI viewed their success record as the result of teamwork and dedicated personnel. It was a record established without the help of, or need for, a formal quality organization until they decided to build a nuclear plant, and they then established such an organization not because they believed they needed one, but because NRC's 10 CFR 50 Appendix B required one. Moreover, NRC required that the head of this required quality organization report to the highest levels of utility management. This organization also has the authority to audit the activities of many of the other utility managers who report in at very high levels. Given the situation that (a) PSI did not believe it needed a quality assurance organization to obtain quality in power plant construction, (b) NRC mandated such an organization for nuclear work and (c) the new quality organization not only was vested with certain broad powers but neither it (nor its head) had paid their corporate dues in obtaining these powers, the new quality assurance organization at PSI was greeted with a lack of enthusiasm, a lack of management support, and even a mistrust. Region III's 1979 investigaiton produced internal PSI documentation which showed that PSI executives were cold to the idea of hiring very many people for the quality assurance organization, fearing the development of a quality assurance "empire."

PSI management mistrust of and lack of enthusiasm for the mandated quality assurance organization resulted in a lack of adequate authority or staff (either in size or qualifications) for the quality assurance organization (see Region III report 79-11 on Marble Hill for a more complete discussion of this point).

2. Development of a false sense of security by PSI.

This secondary root cause is somewhat related to the primary root cause, inexperience. NRC's region based inspectors found numerous problems at the Marble Hill site throughout 1978 and 1979, but until right before the August 1979 stoppage of work, PSI (and NRC) did not recognize the full extent of the problems. One PSI staff member (quality assurance) who was there at the time of the problems put it this way (paraphrased): "NRC came in and they found a few things wrong, but that's their job. They didn't communicate to us that we had any really serious problems. Since we viewed them as the experts, we felt that we probably didn't have any major problems." This opinion was corroborated by others involved at the time, including very senior PSI management.

Heavy reliance on contractors also caused PSI to develop a false sense of security. Here, too, PSI felt that the contractors were the experts and that if anything went wrong, the contractors would address it.

Another contributor to PSI's false sense of security is the fact that Marble Hill is a replicate of the Byron plant, which is being built for Commonwealth Edison. PSI made extensive use of design and licensing documents prepared for Byron, and PSI felt that most major problems in construction would surface at Byron first and the Marble Hill project could be reprogrammed to take advantage of the Byron experience.

3. Failure of PSI (or someone) to manage the Marble Hill project from the outset.

This secondary root cause overlaps the primary root cause, inexperience, but it is of such fundamental importance that it should be highlighted as a root cause in its own right.

Perhaps PSI did not effectively take control of the Marble Hill project from the outset because they know they had no prior nuclear project experience, and so they would rely more heavily on contractors than was their normal mode of operation. In any event, PSI, acting as the project's general contractor, did relinquish too much of the day-to-day management of the project to surrogates, they failed to establish and effective project management presence at the construction site (they tried to manage in a matrix arrangement from corporate headquarters), and they diluted accountability within the corporation for project responsibility. All of these failure-to-manage factors

(plus over reliance on replication) contributed to the construction problems that led to the 1979 shutdown.

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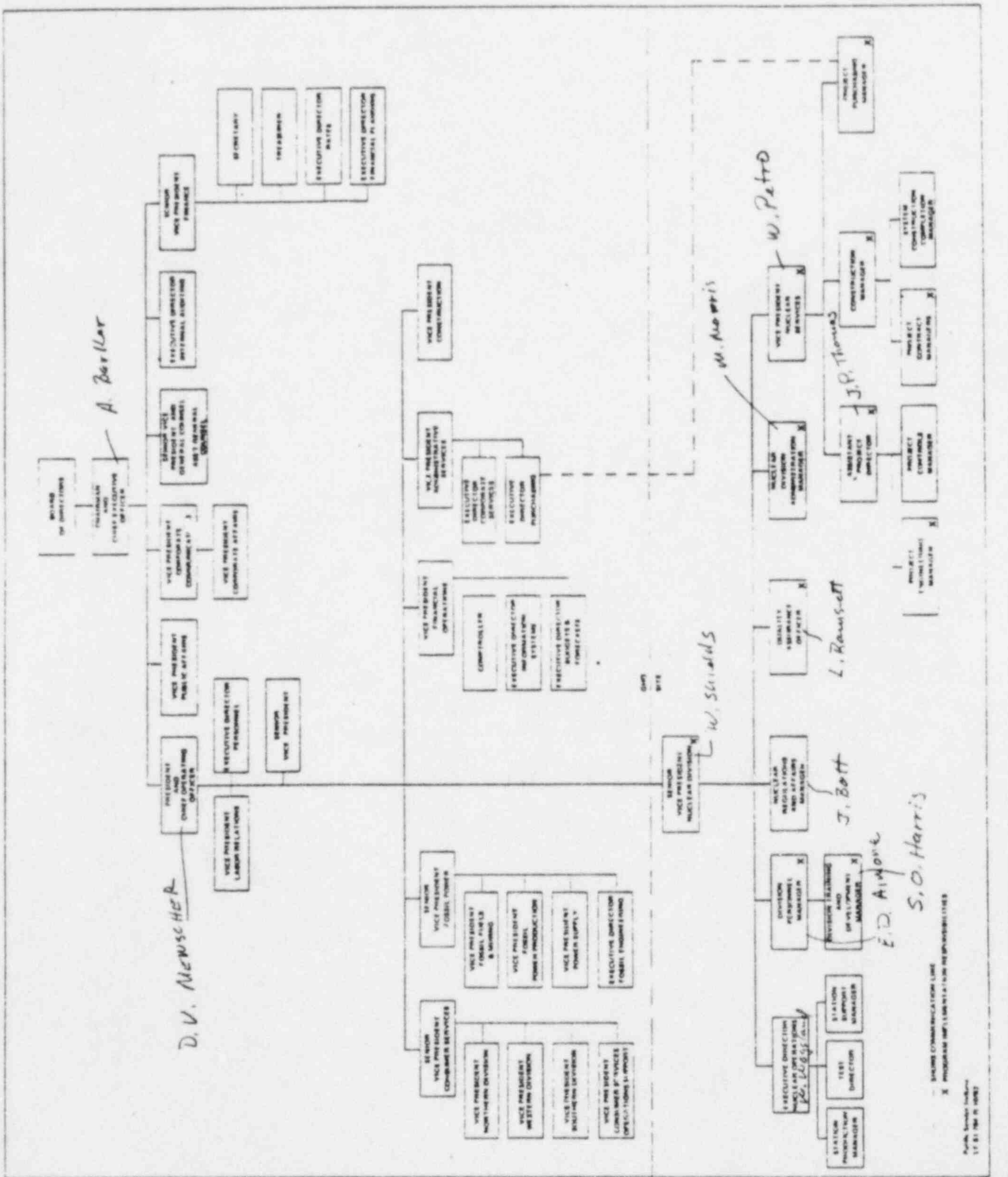
NRC's inspection program for the Marble Hill project consisted of a series of visits by regional based (Chicago) inspectors. A resident inspector was not assigned to the site until December 1979. During our visit to Marble Hill, PSI's president (and other PSI officials) expressed the view that a constant NRC presence in the form of a resident inspector is most critical from the very beginning of construction. They felt that occasional visits by a series of regional inspectors would not provide any of them individuality or NRC with the comprehensive feel for or command of a project that a resident would obtain. Moreover, they felt that bad practices developed during the early stages of construction carry over into later work and the time to catch these practices and correct them is at the beginning. Waiting until the project is 15% complete can permit poor practices to

become accepted and ingrained and much harder to ~~farm~~ turn around. They said they thought assignment of a resident to Marble Hill from day one of construction would have been great help in recognizing Marble Hill's problems earlier and before they became as extensive as they were.

Finally, the enforcement signals sent to PSI by NRC were confusing to PSI. On the one hand, NRC was late to recognize the extent of the problem. This helped reinforce PSI's false sense of security. On the other hand, when NRC did recognize or suspect the extent of the problems, PSI was late to understand the significance of NRC's new, stronger message.

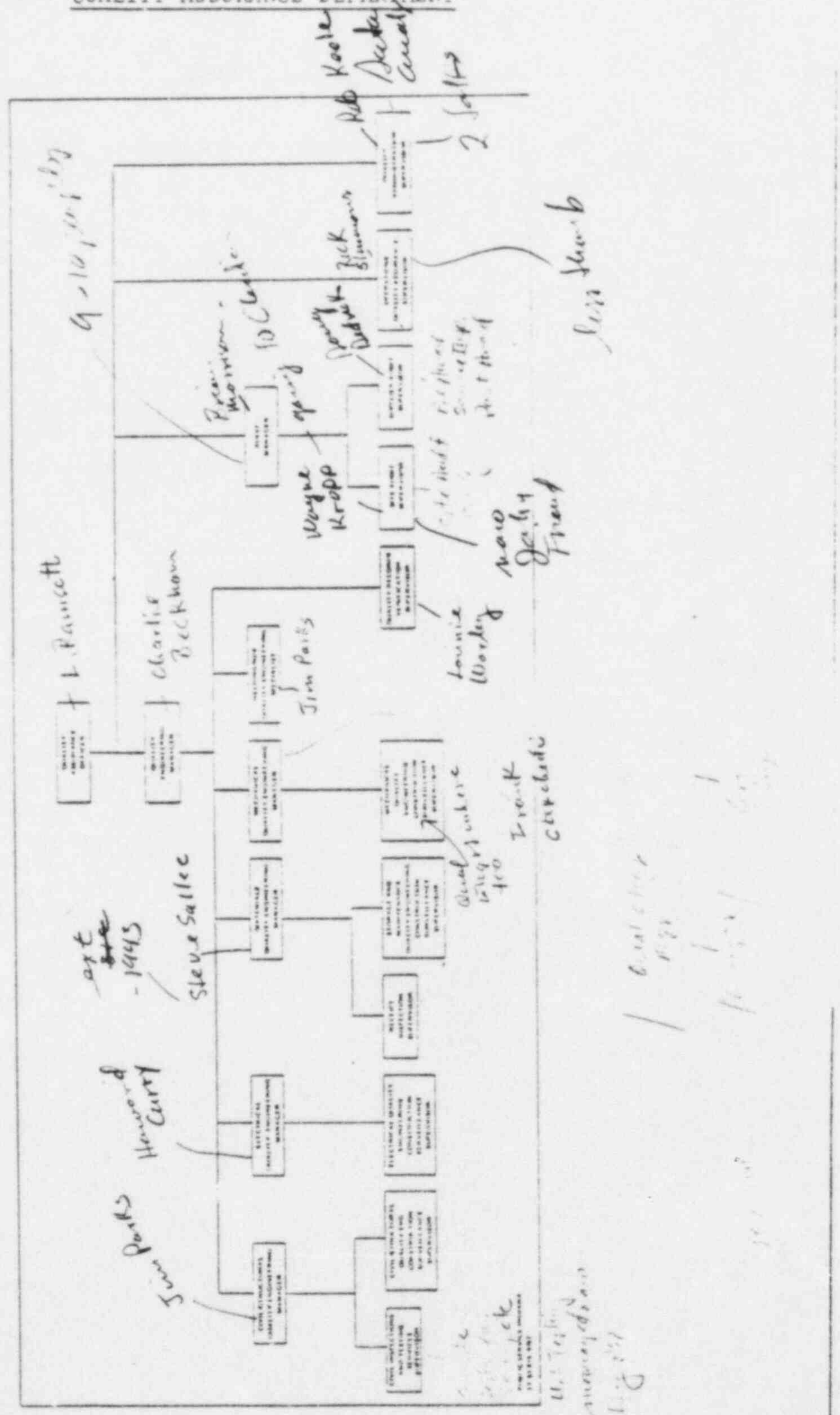
ATTACHMENT A

OVERALL MARBLE HILL PROJECT ORGANIZATION



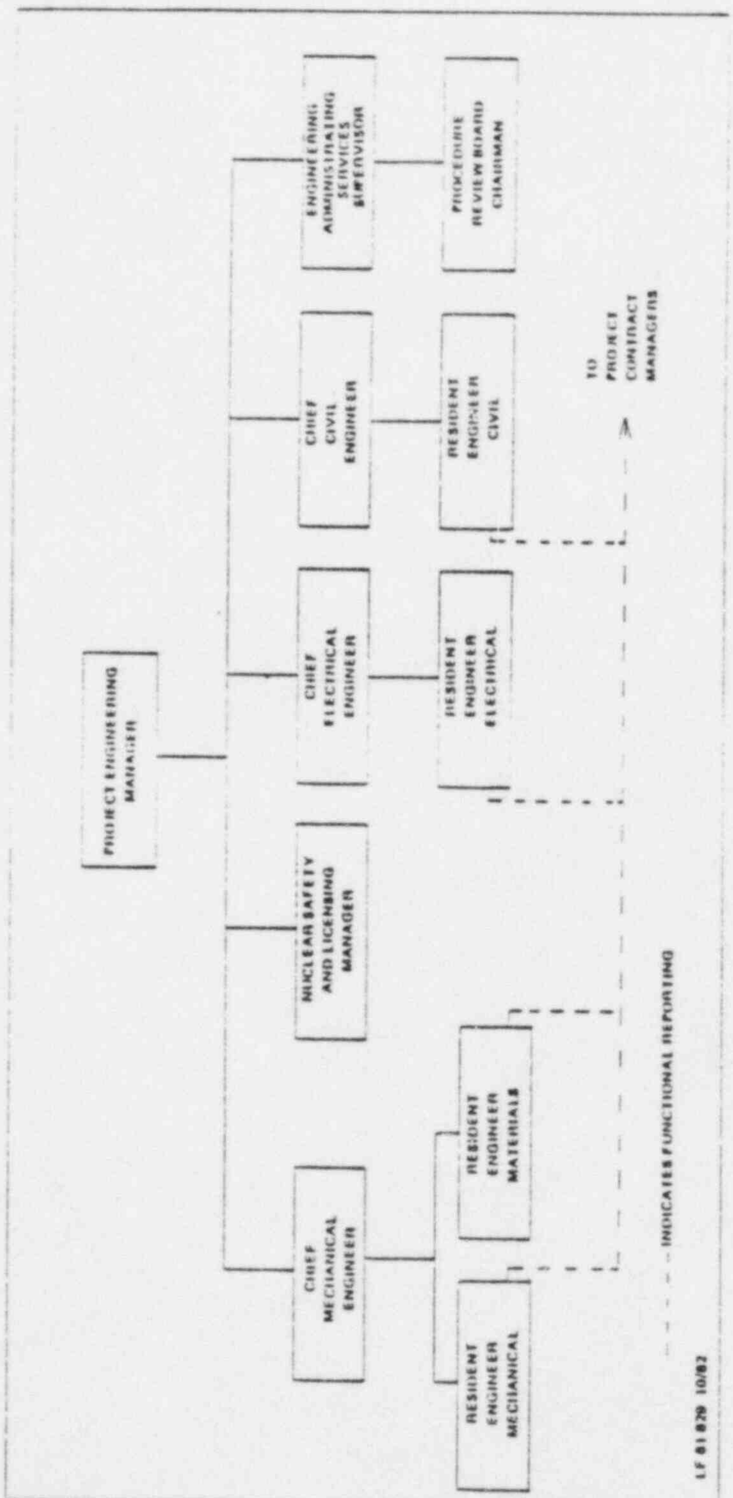
ATTACHMENT B

QUALITY ASSURANCE DEPARTMENT



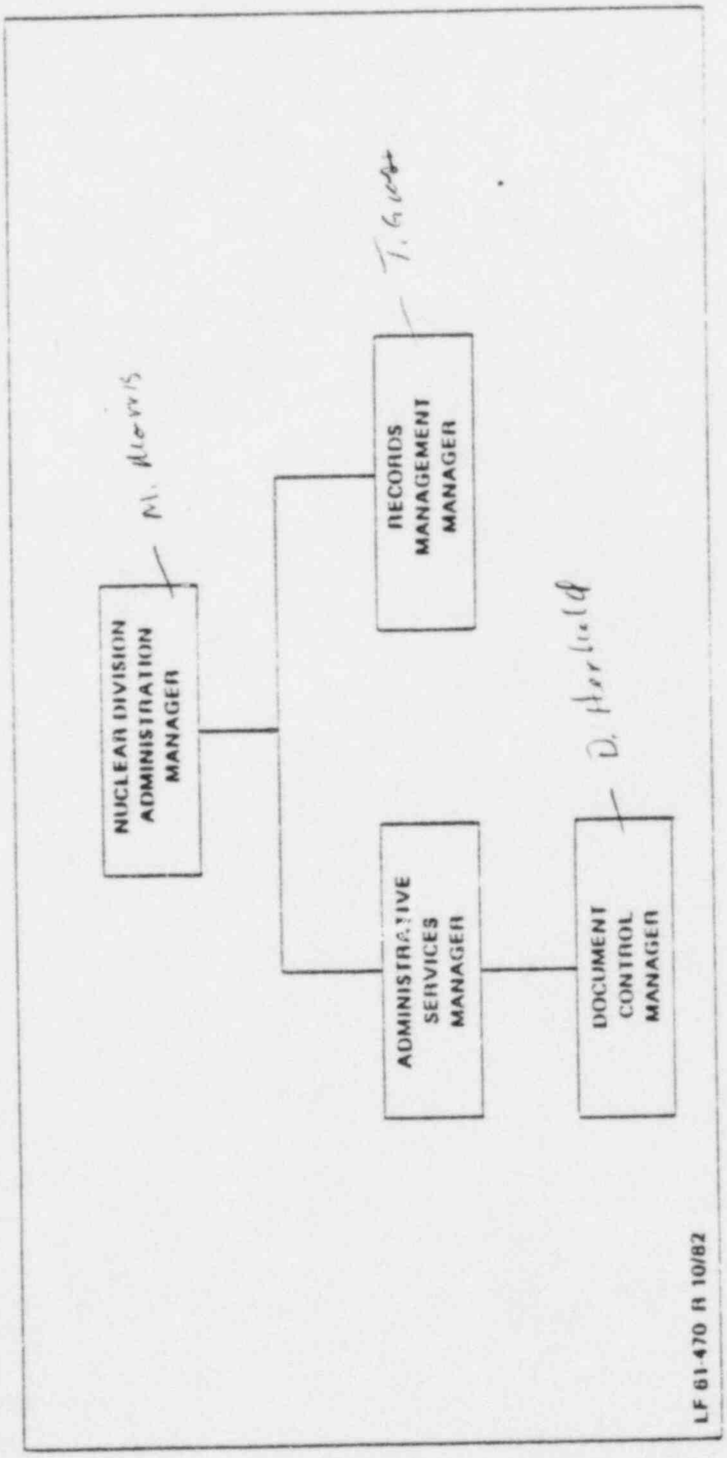
ATTACHMENT C

PROJECT ENGINEERING ORGANIZATION



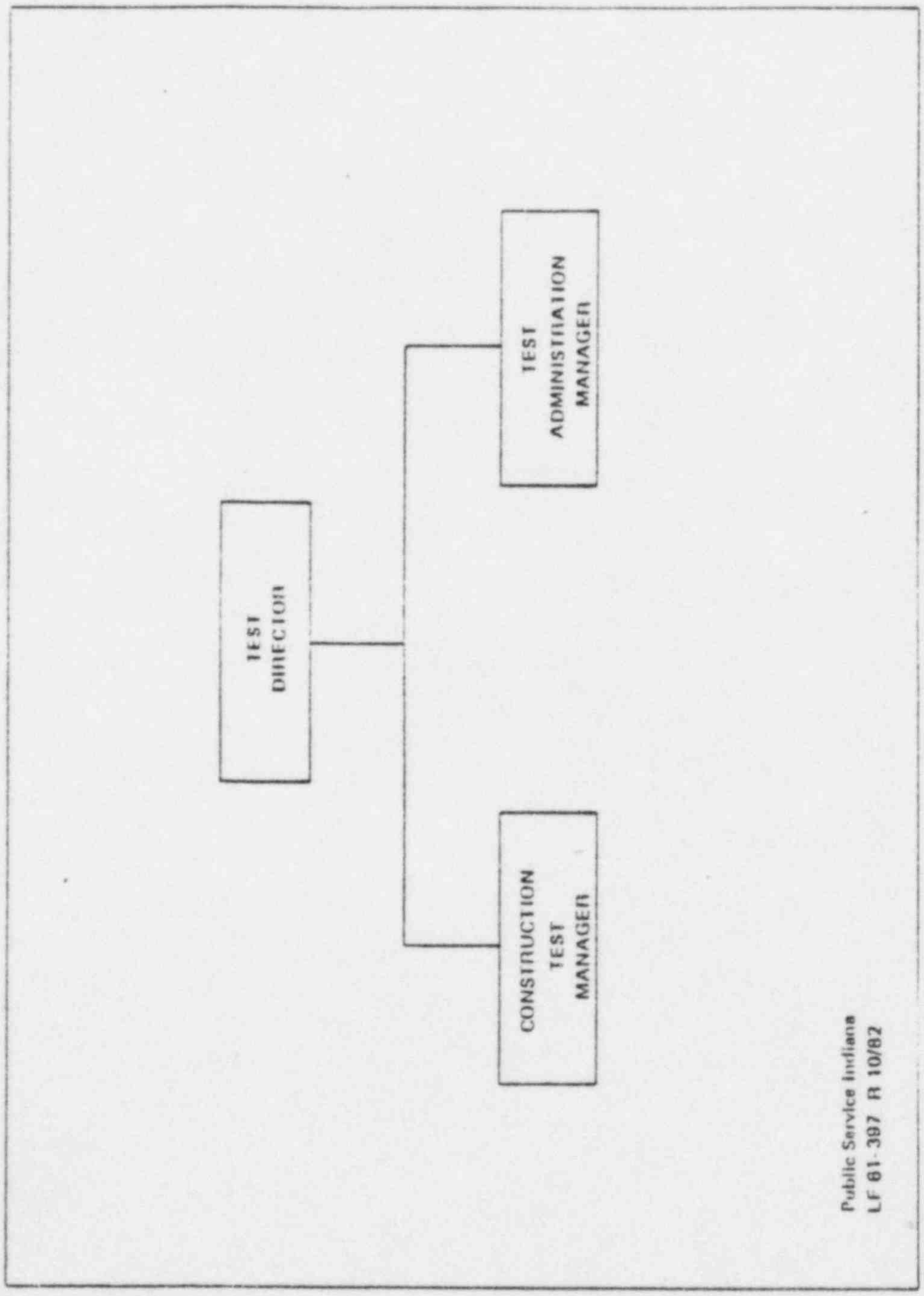
ATTACHMENT D

DIVISION ADMINISTRATION ORGANIZATION



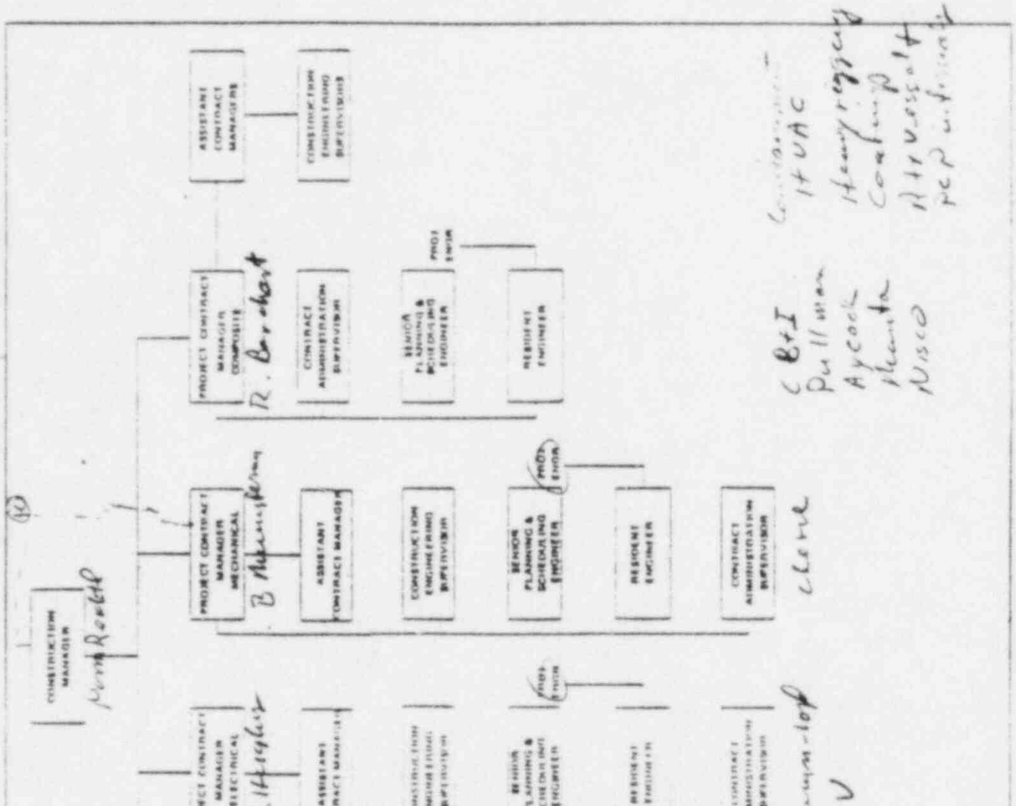
ATTACHMENT E

TEST ORGANIZATION



ATTACHMENT F

PROJECT CONTRACT MANAGEMENT ORGANIZATION



POSTULATED ROOT CAUSES AND SYMPTOMS

I. MANAGEMENT COMMITMENT TO QA/QC INADEQUATE BECAUSE:

- COMMUNICATION CHANNELS INEFFECTIVE
  - FAILURE TO COMMUNICATE MANAGEMENT COMMITMENT DOWNWARD
  - MANAGEMENT NOT RECOGNIZING CONTENT OF MESSAGES UPWARD TO TAKE CORRECTIVE ACTION
  - ORGANIZATION STRUCTURE AND GEOGRAPHICAL LAYOUT TOO COMPLEX
  - FAILURE TO IDENTIFY TRENDS REQUIRING CORRECTIVE ACTION

POSTULATED ROOT CAUSES AND SYMPTOMS (CONTINUED)

- NO CONFIDENCE IN QA/QC AS A CONTRIBUTOR TO PROJECT MANAGEMENT
  - LACK OF UNDERSTANDING OF QA/QC PHILOSOPHY
  - QA/QC LOOKED UPON AS A NECESSARY EVIL (DOING MINIMUM TO GET BY)
  - UNRESPONSIVENESS TO REQUESTS FOR STAFFING AND CORRECTIVE ACTION
  - FAILURE TO RECOGNIZE NEED FOR QA/QC PROGRAM

POSTULATED ROOT CAUSES AND SYMPTOMS (CONTINUED)

II. INADEQUATE FRONT END DEMONSTRATION BY UTILITY OF ABILITY TO MANAGE A NUCLEAR PROJECT

- INADEQUATE SELF-ASSESSMENT OF CAPABILITY
- FAILURE OF NRC TO PROPERLY ASSESS UTILITY'S NUCLEAR PROJECT CAPABILITY

POSTULATED ROOT CAUSES AND SYMPTOMS (CONTINUED)

III. LACK OF UNDERSTANDING OF COMPLEXITY AND MAGNITUDE OF A NUCLEAR PROJECT

- INSUFFICIENT NUMBERS OF QUALIFIED PEOPLE AND WEAK QUALIFICATIONS
- COST AND SCHEDULING EFFORTS INADEQUATE TO GET REALISTIC PICTURE
- LACK OF UNDERSTANDING OF NUCLEAR CODES, STANDARDS, AND REGULATORY GUIDES
- HEAVY RELIANCE OR REPLICATION APPROACH

POSTULATED ROOT CAUSES AND SYMPTOMS (CONTINUED)

- FAILURE TO RECOGNIZE NEED FOR A COMPREHENSIVE AND INDEPTH TRAINING PROGRAM

- OVER RELIANCE ON SUBCONTRACTORS QA/QC PROGRAM

- INADEQUATE PROJECT MANAGEMENT MECHANISM FOR PLANNING CONTRACT WORK SUFFICIENT TO ALLOW FOR EFFECTIVE QA/QC WORK PACKAGES

POSTULATED ROOT CAUSES AND SYMPTOMS (CONTINUED)

IV. CREDIBILITY AND COST EFFECTIVENESS OF QA NOT DEMONSTRATED

- EXCESSIVE CONTROLS ON QA
- STOP WORK AUTHORITY LIMITED
- LIMITED MANPOWER

V. NO FRONT END DIRECTION GIVEN TO INEXPERIENCED UTILITIES BUILDING FIRST NUCLEAR PLANT (UTILITIES GET COMPLETELY IN TROUBLE BEFORE NEED FOR CORRECTIVE ACTION IS IDENTIFIED)

4

MEMORANDUM FOR: Terry L. Harpster, Chief, Quality Assurance Branch
Division of Engineering and Quality Assurance, IE

FROM: Willard D. Altman, Project Manager, Special Study of Nuclear Quality Assurance

SUBJECT: TRIP REPORT ON THE MARBLE HILL CASE STUDY

During the week November 15-19, 1982, a team of consultants and I conducted a quality assurance case study of the Marble Hill construction project. On Monday November 15, we briefed interested members of the Region III staff on our project and solicited their comments on our project and approach in general and about Marble Hill in particular. We spent Tuesday through Friday at the site, interviewing members of the staffs of PSI (Public Service of Indiana) and their contractors, and reviewing their project management, construction, and quality assurance programs. Enclosure 1 gives a day-by-day schedule of activities for the team and includes listings of attendees for the November 15 meeting with Region III and the November 16 and 19 entrance and exit meetings, respectively, with PSI. Enclosure 2 consists of the briefing slides presented at the meeting at the region and the entrance briefing with PSI. Enclosure 3 consists of the briefing slides I used for the exit meeting with PSI on November 19.

At this point individual team members are reviewing their notes and preparing for me feeder information that will be used as background and source information for our generic reports to Congress and the Commission. While this

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information is being prepared and analyzed, I thought it would be instructive to share with you some preliminary lessons learned from the Marble Hill case study and what the information we have so far obtained on Marble Hill (from reports, investigations, Region III, the resident, PSI executives and staff, PSI contractors, etc.) may portend for the rest of our study. These preliminary thoughts and ideas form the basis for the exit briefing we have with PSI on November 19.

Subsequent paragraphs will describe what quality problems have occurred at Marble Hill, and where PSI is now in terms of their quality program. We will then describe the root causes of their past quality problems, how they turned their program around, what generic implications their experience may have, and finally what effects NRC's QA initiatives and the Ford Amendment alternatives would have had had they been in place at the time Marble Hill's quality problems surfaced.

Notes From Marble Hill Case Study

I. What Happened at Marble Hill

Include this in the team report

In April 1978, NRC issued to PSI construction permits for the construction of two 1150 Mw Westinghouse four loop PWRs at the Marble Hill site near New Washington, Indiana. PSI had announced construction of the units in November 1973 and applied for a CP in July 1975. A limited work authorization was granted in __________ 1977, and PSI acted as general contractor for the project, which was the first nuclear project undertaken by the utility. Sargent and Lundy was retained as architect/engineer. The Newberg Construction Company, which had participated in the construction

of a number of fossil-fired power plants for PSI in the past, was retained as the civil contractor for the Marble Hill Nuclear Station. Subsequent paragraphs describe the problems of quality in construction that developed at Marble Hill. This material is excerpted from testimony delivered by J. J. Harrison, NRC Senior Resident Inspector at Marble Hill, to Congressional aides in February of 1982.

Background

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NRC inspections of concrete work underway in April and May, 1979, identified deficiencies in the control of quality during concrete placement at Marble Hill. In a meeting with Region III on May 15, Public Service of Indiana (PSI) agreed to upgrade its quality assurance program for the concrete work and to determine through testing if previously poured concrete was adequate.

In June a former site employee alleged that surface defects in the concrete had been improperly patched, and in July the National Board of Boiler and Pressure Vessel Inspectors identified code-compliance problems with piping installation.

Concrete work was halted June 26 at the request of Region III; then briefly resumed in July before all safety-related construction work was halted August 7, 1979, by PSI after NRC inspectors determined there was significant questions concerning PSI's quality assurance program and its construction management.

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These findings were based on NRC inspections of concrete placement, repairs and testing procedures, on the confirmation of allegations by construction workers at the site, and on the finding of the National Board of Boiler and Pressure Vessel Inspectors.

A confirmation order was issued by the NRC staff on August 15, 1979.

A full time NRC Resident Inspector was assigned to Marble Hill on December 3, 1979.

After numerous meetings with the NRC, PSI submitted on February 28, 1980, its formal reply to the order, detailing its effort to upgrade and implement its revised QA program.

One month later, on March 25, 1980, a public meeting on the proposed corrective action was held by the NRC before some 500 local residents in Madison, Indiana.

To assure that PSI's corrective actions were properly and effectively implemented, the Commission approved a five-step plan for gradual recission of the order. The five stages would be subject to intensive reviews by NRC inspectors with an NRC "hold point" at each stage before the next could be undertaken. Additionally, there were intermediate "hold points" within each stage.

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The plan covered: (1) Revised Quality Assurance Program; (2) Receipt Inspections; (3) Material Verification Program; (4) Construction Verification Program; (5) Resumption of Constuction.

One major concern of the NRC's was the apparent low number of qualified QA and management personnel at the site. This concern was addressed by the licensee with an accelerated hiring and training program and a shifting of personnel to the plant site. Currently the entire Nuclear Division is at the site.

Two independent outside consultants were also retained by the NRC to provide an independent analysis of the concrete work, which had been requested by Save-the-Valley a Madison, Indiana, public interest group. A third engineer, representing Save-the-Valley accompanied the NRC consultants during their review at the site.

After PSI restructured its QA and Construction Management Programs, it was permitted on July 7, 1980, to resume receipt inspections of materials at the construction site, and later contractors were also permitted to undertake receipt inspections.

On December 5, 1980, the NRC permitted limited electrical work and pipe installation to resume by Cherne Contracting Co., the piping contractor, and Commonwealth Lord, the electrical contractor. Then on March 27, 1981, PSI was authorized to resume all remaining safety-related work, including concrete placement. Unrestricted authority to continue the work would not

be granted until the utility successfully demonstrated that its quality assurance and construction management programs were implemented properly.

The additional work authorizatrion included concrete repair and placement, structural steel installation and protective coatings. In addition to new concrete work, PSI contractors began removing and replacing all patches previously made to repair surface defects in the concrete, about 6,400. As of February 13, 1982, the patching program is about 82 percent completed.

An NRC review of tests and examinations concluded that the exisitng in-place concrete work was structurally sound. This determination was based, among other things, on tests performed by PSI contractors and observed by NRC personnel.

The NRC's independent consultants also concluded that the quality of the concrete at Marble Hill was acceptable.

Recent Statistical Issue

The Commisisoners recently declined, on January 6, 1982, to review Director Stello's March 27, 1981, order allowing resumption of safet-related concrete work at Marble Hill. The request had been made through a 2.206 petition from Save-the-Valley, which claimed that the statistical methodology used to test in-place concrete was faulty. The NRC had approved a four-stage sequential testing plan to determine the adequacy of in-place concrete at Marble Hill. The concrete had to meet the NRC's 95/95 criteria;

that is, the NRC had to have 95 percent assurance that no more than 5 percent of the concrete was possibly defective.

Save-the-Valley claimed the sequential plan, if carried through, would provide only a 90/95 assurance factor. The plan: if one defect was found in the first 59 areas tested, then the test would be expanded to 93 areas. If another defect was found, the test would be expanded to 124 areas, and finally to 153 areas if a third defect was found.

L.D.Y. Ong, of NRC's Office of Policy Evaluation agreed with Save-the-Valley stating that the sequential plan would indeed only provide a 90/95 factor. However, it was pointed out that the whole argument was moot since no defects were found in the first 59 areas tested. As a result, there was no need to go any further. Zero defects in the 59 areas equaled 95/95, and thus met NRC requirements.

3. ~~II~~. Marble Hill Today

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In an October 26, 1981 inspection report on Marble Hill, Region III inspectors stated in item 12, "Summary Findings of This Special Inspection: It is Region III's conclusion that PSI has adequately implemented its commitments made in response to the August 15, 1979, Order Conforming Suspension of Construction and the related conventions and agreements in accordance with the NRC's document entitled Graduated Recission of Order August 15, 1979."

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On February 12, 1982, following a site visit by NRC management, the "Confirming Order" was lifted, thus enabling construction to continue with no restrictions.

Note: Region III has rated the Marble Hill QA program "outstanding" in the last 2 SALP reports.

III. Root Causes of Marble Hill's Problems with Quality in Construction

Based on our review of NRC and other documentation regarding the Marble Hill case and our discussions with cognizant NRC, licensee, and contractors staff, the following appear to be the primary and secondary root causes of the quality problems that manifested themselves in 1979 and led to the cessation of safety-related work at the project.

A. Primary Root Cause

The primary root cause of PSI's problems at Marble Hill was their lack of experience in building a nuclear project. They simply did not understand or fully appreciate the several quantum jumps of complexity difference between building fossil plants and building nuclear plants. Their experience in building fossil plants had been quite positive: they had built nearly a score of successful fossil plants in the past thirty years, generally completing the projects on schedule (or before) and within budget. This led to the development of a mind set sometimes referred to as a "fossil mentality" - the feeling that building a nuclear plant could not be much more difficult

than building a fossil plant, the main difference being in how the steam was generated.

Their inexperience with nuclear projects, their failure to appreciate the legal and engineering complexity of a nuclear project, and their overall fossil-oriented outlook manifested itself in the manner in which they addressed the project, resulting in several managerial errors which ultimately led to the stoppage of safety-related work. Primary among these errors was a failure to staff the nuclear project adequately, with sufficient personnel having applicable nuclear-related experience. They did staff a few key positions with personnel who had good nuclear credentials, but their procurement of personnel with appropriate nuclear experience was of neither sufficient breadth nor depth to provide reasonable assurance of success.

Another error lay in their understanding, or perhaps misunderstanding, of NRC and its role in the licensing and oversight of nuclear construction projects. With their strictly fossil background, they tended to view NRC as another government agency with another set of regulatory hurdles to engage and complete, much like an EPA or an OSHA. This lack of understanding of NRC contributed in part to their failure to recognize the extent of their problems earlier than they did - they heard what NRC said but they were not really listening (NRC is not above reproach either as will be described later).

Another management error on PSI's part was their over reliance on contractors. They tended to view their contractors as the experts in the areas in which they were working and generally not to question their activities. Moreover, they turned over defacto management of the project to their contractors. (More about this later.)

Similar to their lack of understanding of the importance of NRC and its rules, was a lack of understanding of the importance of various ASME and other codes. This misunderstanding caused them to be slow to recognize the importance or significance of the July 1979 findings of the National Board of Boiler and Pressure Vessel Inspectors referred to in the excerpt from Mr. Harrison's testimony.

Finally, their inexperience (and over reliance on contractors) resulted in their not recognizing or being able to recognize that the symptoms of construction quality problems they saw with the honeycombing of the concrete and improper patching were indications of a much deepter underlying mailiase in their entire program of project and quality management. In short, they saw the symptoms but did not understand nearly how much deeper the underlying causes ran.

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3. failure of PSI to manage the Marble Hill project from the outset, and

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PUBLIC SERVICE INDIANA

LF 85-174 R 6/82

CONDITIONAL RELEASE FORM

Date ______ 6

Serial No. ______

From: PROJECT CONTRACT MANAGER ______ / ______ Date

To: PROJECT CONTRACT MANAGER MATERIALS ______ / ______ Date

To: QUALITY ENGINEERING MANAGER

Conditional release of the items listed below is requested for the following reason:

Description ______

P.O. Number ______ Procurement Spec. ______ Ship I.D. ______

Supplier ______ Storage Level ______

Piece Mark I.D.	Tag No.	NCR/DDN No.
		FOIA-84-293 K/62

______ RECEIPT INSPECTION SUPERVISOR ______ DATE ______ QUALITY RECORDS VERIFICATION SUPERVISOR ______ DATE

Conditional release approved with the following conditions:

______ QUALITY ENGINEERING MANAGER ______ DATE

Authorization to release to contractor

______ PROJECT CONTRACT MANAGER MATERIALS ______ DATE

Closure of conditional release

______ RECEIPT INSPECTION SUPERVISOR ______ DATE

(7-12) (7-9)

PUBLIC SERVICE INDIANA

RECEIVING INSPECTION REPORT

REPORT NO.

DATE

ITEM NAME:	PIECE NO:
P.O. NUMBER:	P.O. ITEM NO:
SPECIFICATION NO:	SIZE & QTY.:
HEAT NO:	DRAWING NO.
LOT NO:	VENDOR NAME:
MATERIAL SPEC:	CHECKLIST & REV.

ITEM NO.	SAT.	UNSAT.	N/A	SIGNATURE	DATE	ITEM NO.	SAT.	UNSAT.	N/A	SIGNATURE	DATE

RESULTS: ☐ ACCEPT ☐ REJECT

☐ ACCEPT WITH COMMENTS: ______

DDN. NO. ______ NCR NO. ______

INSPECTED BY	______ INSPECTOR ______ DATE	MEASURING & TEST EQUIPMENT USED:
REVIEWED BY	______ RECEIVING INSPECTOR SUPRV. ______ DATE	

☐ WITNESSED

☐ REVIEWED

______ ANI ______ DATE

☐ ACCEPT TAG NO: ______

☐ REJECT TAG NO: ______

☐ RETAIN TAG NO: ______

☐ CONDITIONAL RELEASE TAG NO.: ______

LF 85-170 R 6/80

NCR/CAR CONTINUATION SHEET
MARBLE HILL PROJECT

LF 61-479 R 12/80

CONTROL NUMBER

PAGE ________ OF ________

THIS SHEET IS A CONTINUATION OF BLOCK NUMBER ________

TITLE OF THE BLOCK ____

CONTINUATION SHEET PREPARED BY

PRINT NAME	SIGNATURE	DATE

INSTRUCTIONS: EACH BLOCK CONTINUED SHALL HAVE A NEW SHEET STARTED WHICH SHALL BE NUMBERED PAGE 1. ANY SUBSEQUENT SHEETS FOR THE SAME BLOCK SHALL BE NUMBERED CONSECUTIVELY. EACH SHEET SHALL BE SIGNED AND DATED. ENSURE THAT THE APPROPRIATE ATTACHMENT BOX ON THE NCR/CAR IS CHECKED OR THE BLOCK NO. CIRCLED IF NO BOX IS PROVIDED.

CORRECTIVE ACTION REQUEST
MARBLE HILL PROJECT

LF 85-103 R 12/80 - 2

1. Control Number

2. Date

3. Safety Related? ☐ Yes ☐ No

4. Code ID

5. Procedure/Specification Violated

6. PO Number

7. Spec. No.

8. Stop Further Processing? ☐ Yes ☐ No

9. Stop Work Order? ☐ Yes ☐ No

10. Stop Work Order No.

11. NCR No. Attachment ☐

12. Surveillance/Inspection Report No.

13. Initiators Organization — Code

14. Responsible Organization — Code

15. Adverse Condition:

Attachments ☐

16. Initiator

Print Name — Signature — Date

17. Validated By:

Initiator's Supervisor — Date

18. Reportable Per 10CFR21 Or 50.55(e)? Yes ☐ No ☐

19. Request for Evaluation No.

20. Quality Engineer — Date

21. Response Due Date

22. Deficiency Code

23 Cause Code

24. Corrective Action:

Attachments ☐

25. Responsible Organization — Dispositioned By/Title — Date

26. Date Corrective Action Will Be Fully Implemented.

27. Approval: Quality Assurance — Date

28. Authorized Nuclear Inspector — Date

29. Verifying Organization — Code

Verification of Completion of Corrective Action

30. QA Inspector/Engineer

NONCONFORMANCE REPORT
MARBLE HILL PROJECT

LF 61-109 R 1/82

1. NCR Control Number
2. Date

Description

3. Equipment I.D. Number
4. Serial/Heat/Batch/Lot/etc. No.
5. Location Code
6. Safety Related? Yes ☐ No ☐
7. Code ID.
8. P.O. Number
9. Specification No.
10. Procedure/Specification Violated
11. Surveillance/Inspection Report No.
12. Drawing Number
13. Stop Further Processing? Yes ☐ No ☐
14. Stop Work Order? Yes ☐ No ☐
15. Stop Work Order No.
16. Car No.
17. Responsible Organization — Code
18. Retain Tag No.
19. Conditional Release Tag No.
20. Initiator Organization — Code
21. Description of the Nonconformance:

22. Affected Documents:

23. Initiator
Print Name — Signature — Date
24. Validated By
Initiator's Supervisor — Date

QA Review

25. Reportable Per 10CFR21 Or 10CFR50.55e? Yes ☐ No ☐
26. Request for Evaluation No.
27. Quality Engineer — Date
28. Deficiency Code
29. Cause Code

Disposition

30. Dispositioning Organization — Code
31. Disposition: (Circle One Only) ASME ☐ Use-As-Is Rework Repair Reject
32. Disposition Justification:

33. Implementation Instructions:

34. Implementing Organization — Code
35. Proposed Completed Date
36. Verifying Organization — Code

Disposition Approval

37. PSI Project Engineer — Date
38. Signature — Date
Company

QA Approval

Disposition Approval

39. PSI Quality Engineer — Date
40. PSI Authorized Nuclear Inspector — Date

HOLD POINTS: none ☐ attached ☐
HOLD POINTS: none ☐ attached ☐

Close Out

Implementation Verified

41. PSI QA Dept. — Date
42. ANI — Date

Tags Cleared:

43. PSI QA Dept. — Date

7

SALP HISTORY

DATES	SALP NUMBER	NONCOMPLIANCES	HOURS
7/1/79 6/30/80	SALP I	24	4110
7/1/80 9/30/81	SALP II	3	3910
10/1/81 9/30/82	SALP III	6	1924

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K/63

MARBLE HILL NONCOMPLIANCE HISTORY

YEAR	INSPECTOR HOURS	TOTAL 1 YR. NONCOMPLIANCE	INSPECTOR HOURS/NONCOMPLIANCE
1977	138	2	69
1978	421	9	46.7
1979	1836	22	83.4
1980	4634	13	356.5
1981	2296	3	763.3
1982 (THRU 9/30)	1446	3	482.0
	10,771	52	207.1

RIII (SIX (6) YEAR HISTORY)/SITE*

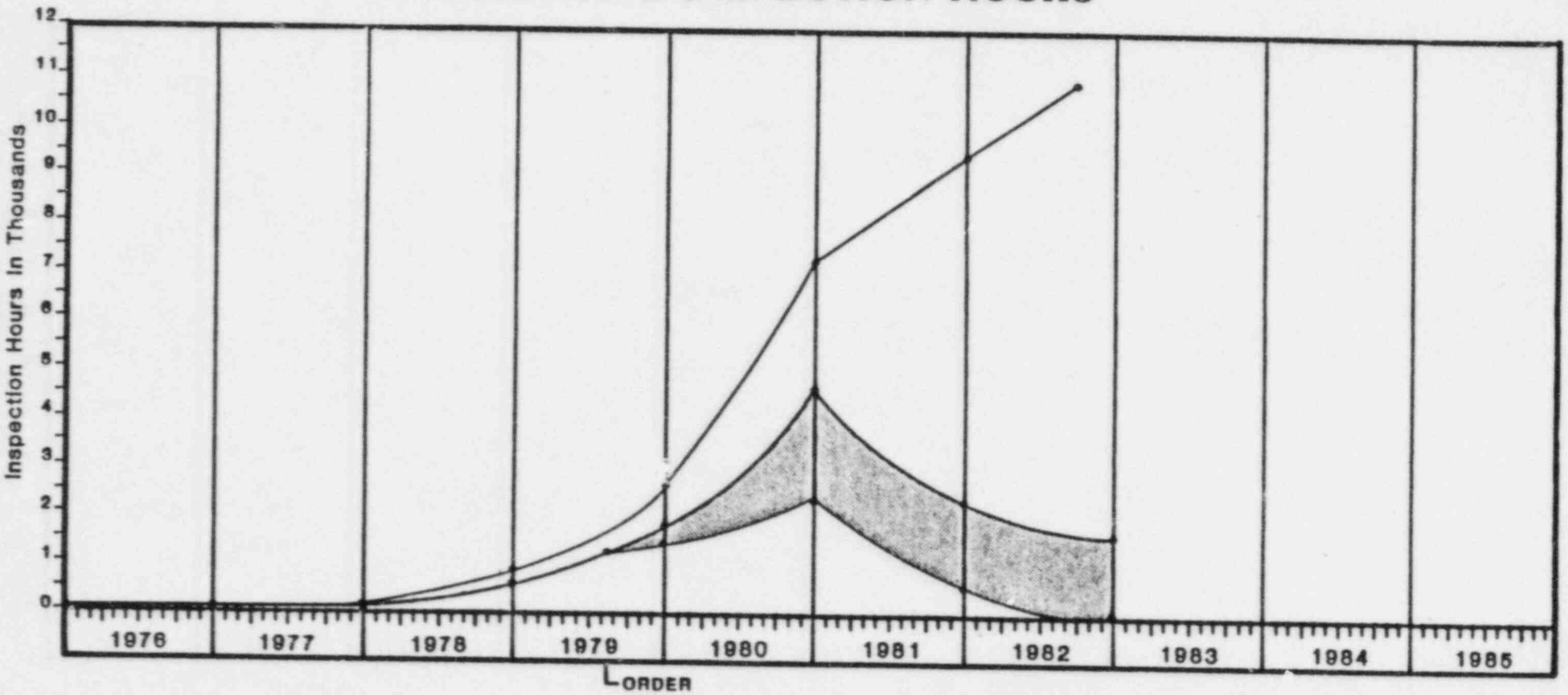
	HOURS	NONCOMPLIANCE	INSPECTOR HOURS/NONCOMPLIANCE
LOW (RIII)	2,649 (BRAIDWOOD)	43	61.6
	4,653 (BYRON)	77	60.5
HIGH (RIII)	22,390 (LASALLE)	141	158.8
AVERAGE	5,463	53.7	101.7

*NOTE: 1982 DATA INCOMPLETE

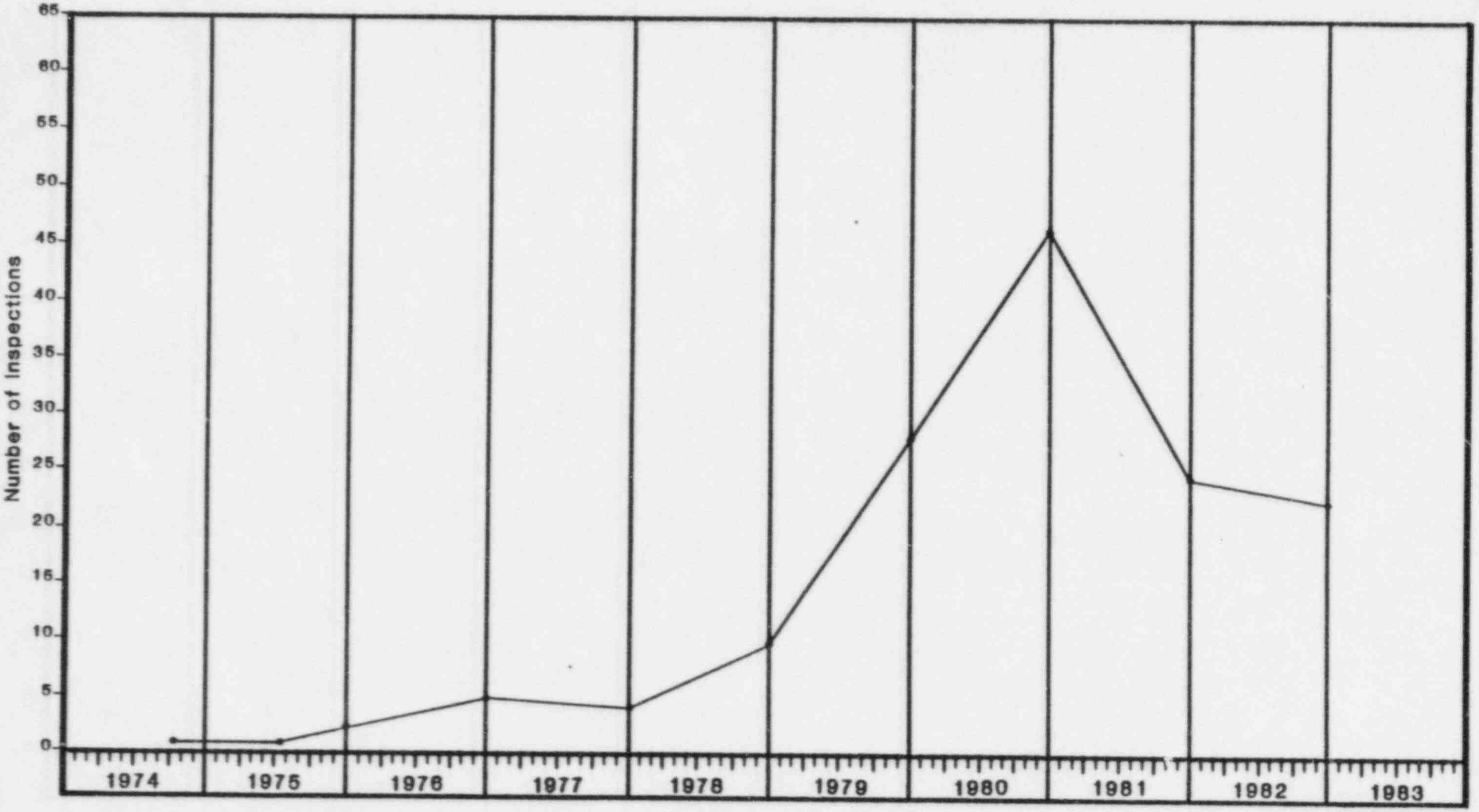
NRC INSPECTION HOURS PER YEAR

RESIDENT INSPECTION HOURS

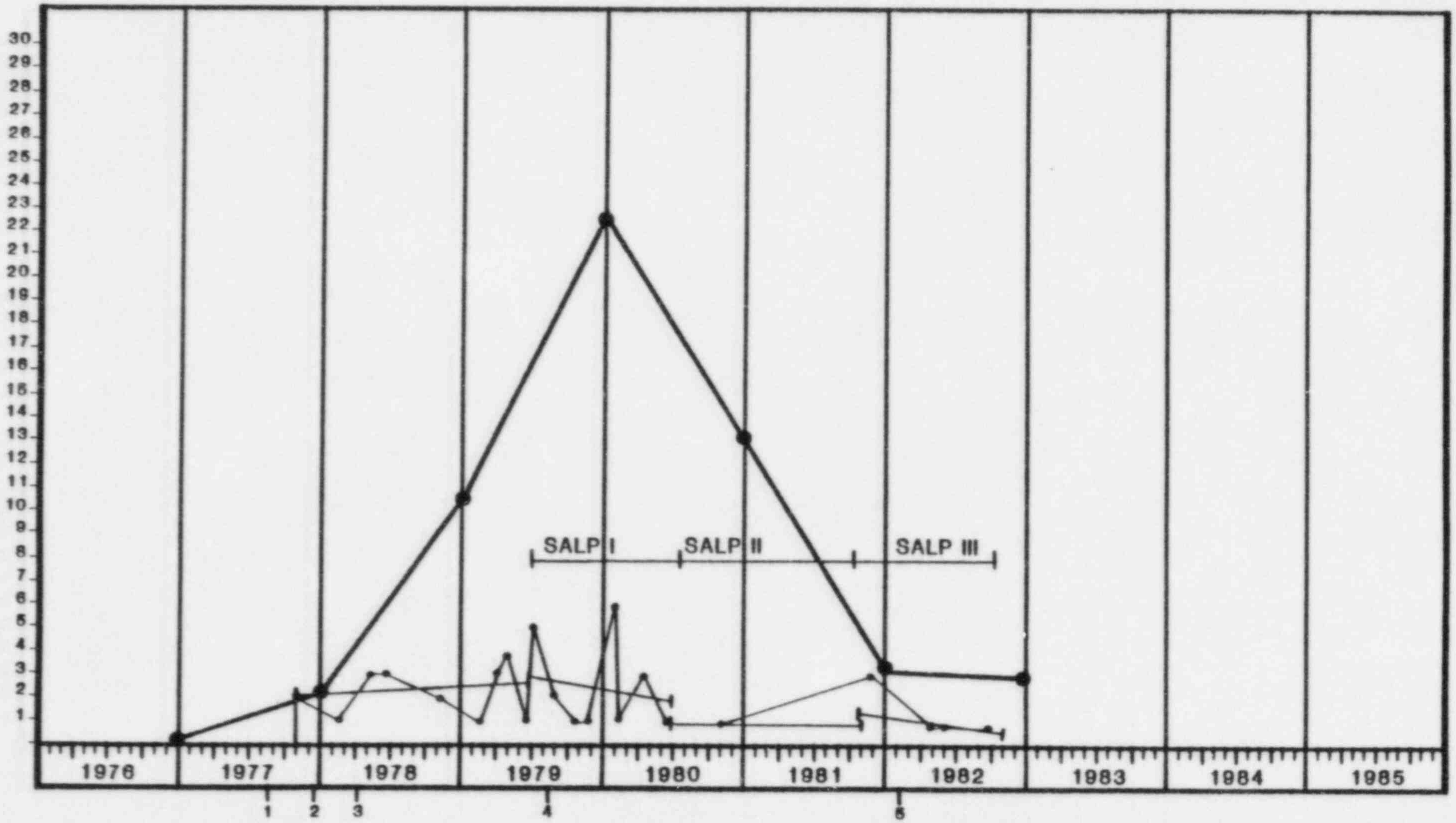
CUMULATIVE INSPECTION HOURS



NRC INSPECTIONS PER YEAR



NRC NONCOMPLIANCES



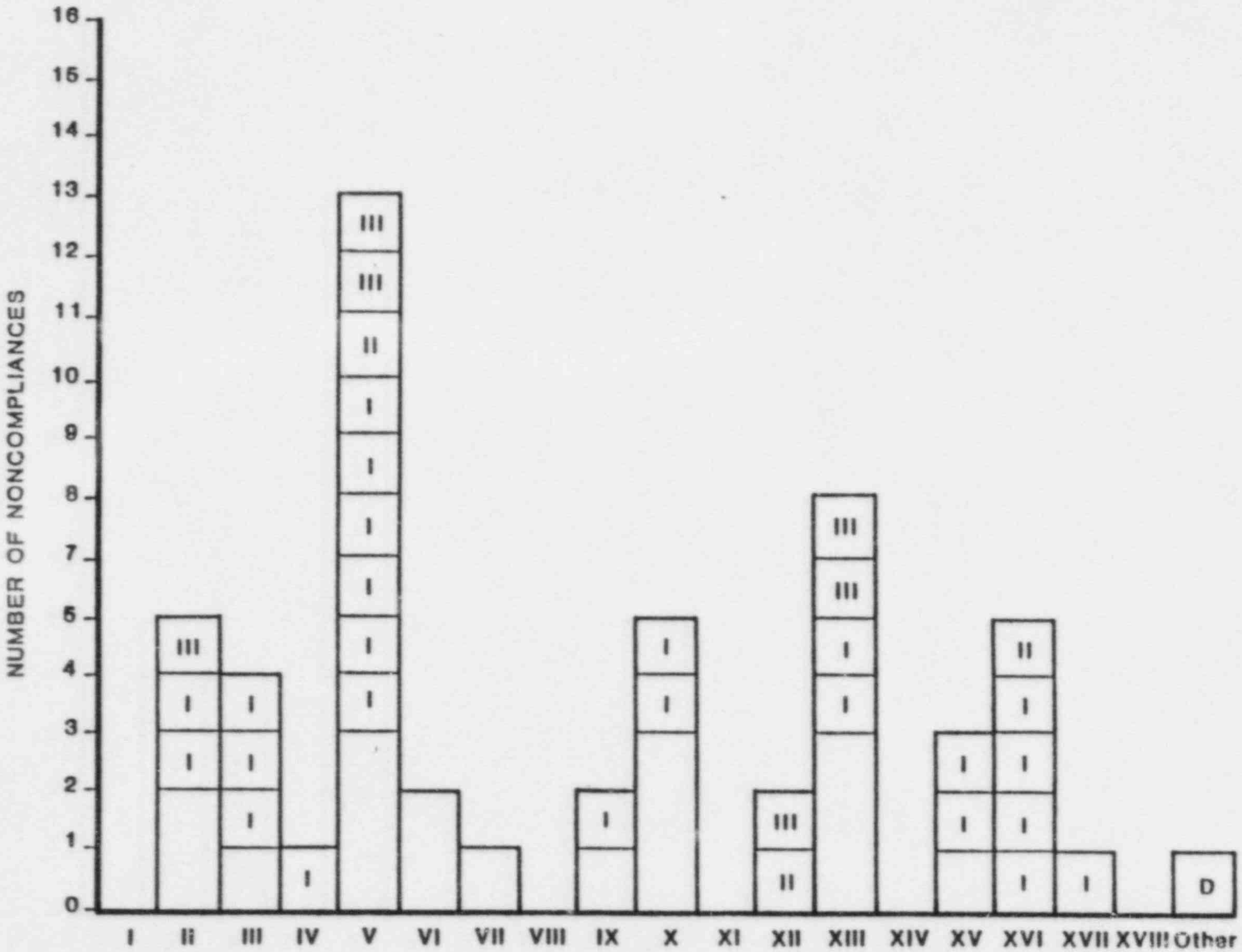
(1) LWA-2 8/24/77

(2) LWA-2 12/13/77

(3) CP 4/4/78

(4) ORDER 8/15/79

(5) LIFTING OF ORDER 2/12/82



10 CFR 50, APPENDIX B CRITERION

undated 8

LONG TERM REVIEW

MARBLE HILL CASE STUDY

Ken:
Be sure to cover each point in these exit notes, My write up on root causes explains the first two pages in detail. Look at my marginal notes on the other pages. Some are brief, but they should give you a good idea of what the bullet means.

ROOT CAUSES

PRIMARY

INEXPERIENCE WITH NUCLEAR PROJECT

- LACK OF ADEQUATE STAFFING
- COMPLEXITY OF PROJECT
- FOSSIL MENTALITY
- MISUNDERSTANDING OF NRC
- OVER RELIANCE ON CONTRACTORS
- LACK OF APPRECIATION FOR CODES
- FAILURE TO RECOGNIZE SYMPTOMS

SECONDARY

LACK OF UNDERSTANDING OF MERIT OF INSTITUTIONALIZED QUALITY PROGRAM

- THOUGHT QUALITY COMES NATURALLY
- RESISTED QUALITY ORGANIZATION - FEAR OF EMPIRE
- ONE ARM
- COMMUNICATION

FALSE SENSE OF SECURITY

- NRC
- CONTRACTORS
- REPLICATION

LONG TERM REVIEW

MARBLE HILL CASE STUDY

SECONDARY

FAILURE TO MANAGE PROJECT FROM OUTSET

- CONTRACTORS

  REPLICATION

- DILUTED ACCOUNTABILITY

NRC LATE INTO PICTURE

- LICENSING LIMITED TO TECHNICAL ISSUES
- IRREGULAR (NON CONSTANT) PRESENCE
- SIGNALS CONFUSING

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LONG TERM REVIEW

MARBLE HILL CASE STUDY

TURN AROUND

- RECOGNITION OF PROBLEM / They finally did recognize they had a problem, and a serious one. For a long time they refused to admit they had a problem. It was not until work was stopped that the extent and seriousness hit them.
- DECISION TO ADDRESS IT SUBSTANTIVELY
  - ° WHY Their corporate future hung in the balance.
  - ° HUMILITY - The company, including the Chairman of the Board, admitted they had been wrong and they changed.
  - ° BE THE BEST - They decided they were not only going to be better but to be the best
  - ° STAFFING, ATTITUDE, MORALE, ETC. - This manifested itself in recruiting the best people they could - in developing a good winning attitude, in improving morale
  - ° DECISION TO MANAGE - Their key decision was to take over control of the project - to manage it, not to let contractors run it for them
  - ° EVALUATE QUALITY ORGANIZATION - They also decided to take the quality function seriously. They elevated the organization's de facto role in the management + conduct of the project
  - ° They embraced the philosophy that — QUALITY IS COST EFFECTIVE
  - ° TEAM SPIRIT - They set up a very visible program to promote the project pride in the project, and the importance of quality. This program helped develop it
  - ° FIRMNESS
- HELP FROM NRC
  - ° 2 X 4
  - ° HIGH STANDARDS
  - ° GOOD RESIDENT

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LONG TERM REVIEW

MARBLE HILL CASE STUDY

GENERIC IMPLICATIONS

- NEED MGMT COMMITMENT TO QUALITY
- EDUCATION
- MANAGE PROJECT
- RESOURCES AND SUPPORT FOR QUALITY ORGANIZATION
- TEAM ATTITUDE
- OVERALL GOOD MGMT
- INTERFACE BETWEEN PROJECT MGMT, CONSTRUCTORS, QA, ETC.
- NUCLEAR EXPERIENCE NECESSARY BUT NOT SUFFICIENT
- QUALITY PEOPLE

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LONG TERM REVIEW

MARBLE HILL CASE STUDY

NRC INITIATIVES

WHICH INITIATIVES MIGHT HAVE MADE A DIFFERENCE AT MARBLE HILL

I.	NTOL	
	1. SELF EVALUATION	NO
	2. REGIONAL EVALUATION	NO
	3. INTEG. DESIGN	NO
II.	INDUSTRY INITIATIVES	
	1. INPO (INCL. MGMT. AUDITS)	YES
	2. UTIL EVAL (WITH OUTSIDE HELP)	YES
III.	CONST. INSP. PROG.	
	1. REVISE PROCEDURES & INCREASE RESOURCES	YES
	2. CAT (WITH INPO)	YES
	3. INTEGRATED DESIGN INSPECTION	NO
	4 EVALUATION OF REPORTED INFORMATION	MAYBE
IV.	DESIGNATED REPRESENTATIVES	MORE NO THAN YES
V.	MGMT	
	1. SEMINARS	YES
	2. QUALIFICATION/CERTIFICATION OF QA PERSONNEL	NO
	3. CRAFTSMANSHIP	NO
VI.	MGMT AUDIT (SUGGESTED BY PSI)	YES

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LONG TERM REVIEW

MARBLE HILL CASE STUDY

FORD

1.	MORE PRESCRIPTIVE A/E CRITERIA	NO
2.	CONDITIONING CP ON DEMONSTRATION OF QA MGMT ABILITY	YES
3.	REVIEW BY INDEP ASSOCIATION OF PROFESSIONALS	MGMT AUDITS YES
4.	IMPROVE NRC'S QA PROGRAM	YES
5.	CONDITIONING CP ON COMMITMENT TO USE INDEPENDENT INSPECTORS	NOT LIKELY/NO

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SOME OBSERVATIONS ON QUALITY ASSURANCE
AT MARBLE HILL NUCLEAR STATION - BEFORE AND AFTER

The Marble Hill nuclear station of Public Service of Indiana was a splendid example of competent personnel, thorough procedures, staff esprit de corps, and top management commitment and involvement in quality matters, all combining to produce what appeared to be a quality construction job.

But this had not always been the case. Prior to the NRC shutdown, the licensee had a "fossil fuel mentality". They had successfully built and operated modern fossil fuel plants, and their attitude toward nuclear was founded on their approach to fossil. Fossil construction was performed under fixed-price (almost turnkey) contracts. Quality-related problems were taken care of after the plant came on line. Many years of experience on the part of vendors, contractors, and utility virtually guaranteed an adequate facility.

So, on Marble Hill, which is a replication of Byron, the licensee had a staff of 75. Now it is 750. The fixed-price contracts were not geared to the level of quality which goes into nuclear plants on an as-constructed basis. Post-startup changes were not permitted. TMI and other added safety considerations were added to the "replicated" design. Still the licensee was insisting the construction contractors meet schedule and cost. So quality suffered, and poor concrete placement practices resulted. The whole concept of QA was not understood or ignored. It didn't exist as a formal activity on fossil plants, so it was an add on for nuclear, required by NRC. It was resented by all. And the matter was not helped as the QA staff politicked for position within the company.

The key factor in the Marble Hill turnaround was the admission by the CEO/Chairman that their approach to nuclear plant construction was wrong. Rather than fight QA and all it implies, the necessary steps must be taken to embrace it. This required a top management commitment to quality which manifested itself as follows: 1) an openness or honesty which permits problems to be aired without threat, 2) an involvement in the "day-to-day" problems which arise in a major construction project, 3) an encouragement to team building (there must be no "we" and "they" anywhere in the organization but an overall common objective to build a quality plant on time and within cost), 4) adequate funding (as manifest in adequate staffing and systems) to do the job. This was the first big change.

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The second major step was to renegotiate all construction contracts to include quality requirements. This necessitated a change from fixed-price contracts to cost plus-type contracts. Under the former contracts the licensee had no say in how poor quality construction should be corrected. In fact, if the licensee could not specify "quality" in the contract, he had no say in how quality should be achieved.

The licensee has found that a constant effort at affirming the commitment to quality is required. This is not a one-time pronouncement. The quality assurance attitude must pervade everybody down to the construction forces. A good QA attitude in management and engineering is not enough. It must be pushed to the grass roots, and that takes some doing because, while the concept of good workmanship is typically there in the crafts, the concept of QA isn't. So team 'uilding efforts are required at all levels (including construction craft and la or personnel, foremen, area superintendents) and there must be a QA discipline instilled in the entire team. The evidence of this is manifest by uniformity in construction (e.g., all bolt heads are on one side, nuts on the other), good housekeeping, lack of graffiti and girlie calendars, no alcoholic beverages on site, etc., and by prompt disciplinary action when called for. All of this is present at Marble Hill.

As previously stated, the licensee had a nuclear staff of about 75 persons devoted to Marble Hill when construction commenced. And most of these had no nuclear experience. It soon became apparent that fossil experience was not applicable to nuclear. The work was far more complex and could not be left to inexperienced (nuclear) construction forces. The licensee had to provide direction. That takes superior personnel in key positions. Obtaining them was the third major step in turning the project around. It takes staff who are experienced and who know they are competent to create a nonthreatening work environment in which openness to problems will be tolerated (and so they can be dealt with). The licensee sought such personnel through recommendations of consultants (MAC) and through head hunters. They were attracted by the opportunity to put good systems and procedures into effect, as well as by position and salary. Obtaining what they have always wanted in systems/ procedures and work environment was precisely the challenge they needed to see the job to completion. [Said another way, adequate procedures/systems exist to complete nuclear plant construction. But superior personnel know that more efficient procedures/systems could be developed to really do the job right. Unfortunately, there are few opportunities to develop them. When

someone is writing to put money where its mouth is (e.g., Public Service of Indiana), the superior personnel sense the opportunity "to do the thing right this time", and buy in.]

The fourth major step was establishing the procedures and attitudes which would permit a quality job. The key personnel knew what procedures were available in the industry, and knew how they should be implemented and/or improved. So from having almost no formal procedures for document control, design changes, QA training, team building, cost/scheduling, etc., the licensee has very solid project controls.

The fifth major step was establishing an esprit de corps to do a quality job on schedule and within cost. The preshutdown organization was divisive, with QA a thing to be tolerated, the construction contractors a "labor force", the NRC the enemy, etc. A lot of things went into this change. The starting point had to be the management attitude and commitment to seeing the job done well.

All is not sweetness and light at Marble Hill. There are storm clouds on the horizon.

Recall that the three components of any project are cost, schedule, and quality. If one can control two of them, then the third can be achieved every time. So for quality to be achieved, there must be flexibility in the schedule and adequate funding. This observation holds true for Marble Hill to the present, but financial constraints on PSI (which also reflect into getting the station completed in the shortest possible schedule) may sorely press quality goals.

- A reinforced concrete radiation shield that's an average of 8½-feet thick encircles the reactor vessel.
- A 4½-foot thick reinforced concrete biological shield surrounds the radiation shield.
- The reactor vessel and shield walls are housed in a containment structure made up of a shell of ¼-inch steel, encased by an outer wall of reinforced concrete that's an average of 3½-feet thick.

Even for people living right next to Marble Hill, routine releases of radiation would be only about as much as that from watching color television. Marble Hill is also designed to withstand tornados or earthquakes that can be expected in the area.

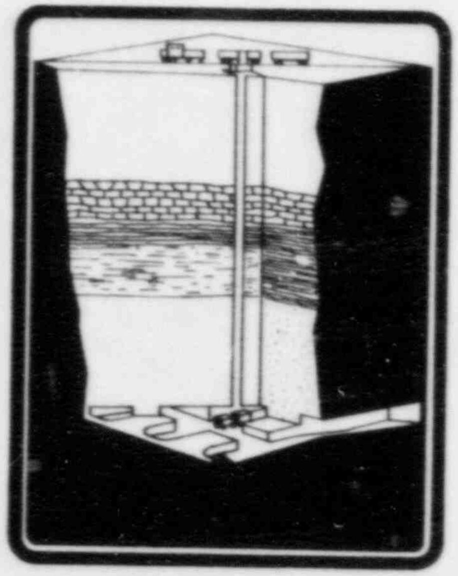
Nothing can be totally safe. And risks associated with the production of electricity from nuclear power plants are considerably less than many risks that are readily accepted by society. Contrary to a widespread misapprehension, it is **impossible** for a nuclear power plant to explode like a nuclear bomb.

Waste Storage

The technology for safely storing high-level waste from nuclear power plants does exist and is being demonstrated. The waste can be turned into solid form and stored deep in the earth.

When spent fuel is reprocessed, the volume of high-level waste produced in a nuclear power plant is quite small. At Marble Hill, all the high-level waste from a full year of operation would fit into a telephone booth. All the waste from the nation's commercial nuclear energy program through the year 2000—both high-level and low-level waste—would fit on a football field in a stack about 30 feet high.

The federal government controls all nuclear waste in the country. Its policy calls for development of permanent sites for waste disposal over the next several years. Until then, nuclear waste is being stored temporarily at the nation's operating nuclear reactors. Temporary storage at Marble Hill can handle 10 to 15 years' worth of spent fuel assemblies.



The Conclusion

Nuclear power isn't perfect. It has its problems and compromises just as any method of producing energy. But we believe it offers an environmentally acceptable and reliable way to supply the large amounts of electricity society depends on. We must also continue to use coal and practice energy conservation. And we must develop the potential new sources that may provide our energy in the next century. Energy shortages can be avoided if we make full use of the energy options we have now.

Tour Information

Group tours of the Marble Hill project can be arranged through the Marble Hill Visitors Center by calling (812) 293-3429. Arrangements should always be made in advance.

You may also enjoy a visit to Public Service Indiana's Heritage Square Nuclear Information Center in Madison. The center is located at the corner of Main and Jefferson streets—across from the Jefferson County Courthouse—and is open from 9 a.m. to 5 p.m. Monday through Friday and 10 a.m. to 3 p.m. on Saturday.

Additional information about the Marble Hill project or nuclear power can be obtained by writing the Marble Hill Visitors Center, Post Office Box 190, New Washington, IN 47162, or calling the telephone number above.

PUBLIC SERVICE INDIANA

MARBLE HILL
nuclear station

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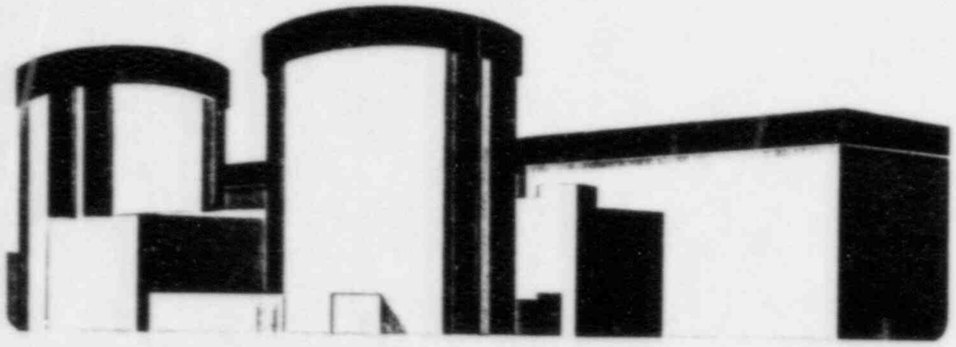


The Marble Hill Project

In 1973, Public Service Indiana announced plans to build a nuclear power plant. That facility—the Marble Hill nuclear power station—is now under construction in southeastern Indiana at a site of about 1,000 acres in Jefferson County near Madison.

Marble Hill's sole function will be to generate electricity. The power will be used by more than three million people in Indiana. The plant will contain two generating units, each capable of producing 1.13 million kilowatts of electricity.

Marble Hill is expected to cost $5.1 billion. Its first unit is scheduled for completion in late 1986, with the second unit expected to go into operation in mid-1988. When the plant is fully operational, it will employ about 750 people.

Public Service Indiana will operate the power plant and own 83% of its 2.26 million-kilowatt capacity. The remaining 17% will be owned by the Wabash Valley Power Association, a group of 24 rural electric cooperatives, and be used by its 300,000 customers.

The nuclear reactors, along with the turbines and electrical generators, are being supplied by Westinghouse Electric Corporation. Design and engineering for the plant are by Sargent & Lundy Engineers of Chicago.

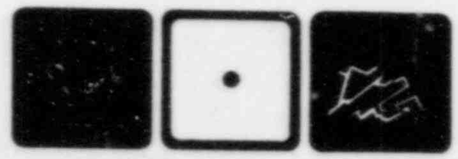
Why It's Needed

Marble Hill is being built to supply electricity to people in Indiana. During those times when Hoosier consumers may not be using all the power from the plant, some may be sold elsewhere. But our own customers come first.

Our complex economy can't function without electricity. The goods and services we depend on would no longer be readily available if the state's utilities couldn't supply enough electricity.

Since consumers in the state continue to use increasing amounts of electricity and present power plants will eventually wear out, Public Service Indiana must keep up with the demand and build more power plants.

An adequate supply of electricity supports jobs in all sorts of industries for an ever-increasing work force; provides power for our environmental clean-up program; replaces those fuels that are in short supply; and provides the means to allow even the lowest income families to improve their standard of living. A shortage of electricity, on the other hand, would mean economic disruptions and hardships for everyone.



The Economic Choice

Throughout the nation, nuclear power plants have been generating electricity for years at a lower cost than their oil, gas or coal-fired counterparts. Marble Hill will be no exception.

Marble Hill will cost more than $5 billion to build—a staggering figure that represents the largest amount of money ever spent on a construction project in Indiana. But this cost will be spread out over the life of the plant.

The savings come in the operation of the plant. The fuel to power Marble Hill for 30 years will cost about $11 billion. But the fuel to power a comparable coal-fired power plant (the next cheapest alternative) for the same 30-year period would cost an estimated $28 billion. That's a $17 billion fuel saving for the people who will use electricity from the plant.

So when the higher construction costs are figured in with the lower operating and maintenance costs, the result is lower-cost electricity from a nuclear power plant.

Safety First

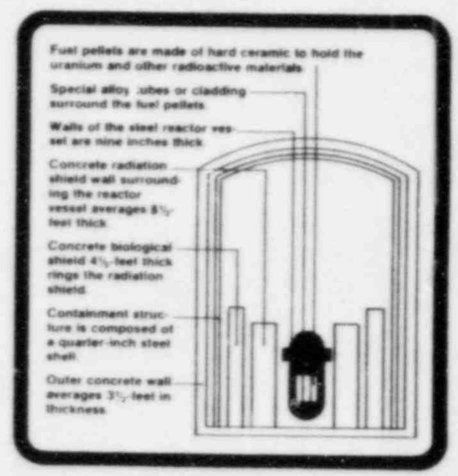
Safety is a top priority at a nuclear power plant.

And as a result, no other industry has as enviable a safety record. Safety has been built in from the beginning and has been continually improved.

Several layers of protection for each system in the plant have provided the extra margin of safety that has protected the public, even in the worst nuclear plant accidents. Marble Hill, as one of the generation of nuclear power plants to be completed after the Three Mile Island accident, will contain even more sophisticated safety systems than its predecessors.

As an example, look at the various layers built into the Marble Hill plant to protect the public and employees from the accidental release of harmful amounts of radiation:

- The uranium fuel pellets are made of hard ceramic to hold the uranium and other radioactive materials.
- The fuel is housed in special metal a loy tubes.
- The reactor vessel where the nuclear reaction takes place is a steel structure with walls nine inches thick.



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14

On June 26, 1979, a second meeting was held with PSI officials to discuss the findings of the investigation at that point and the fact that the deficient repairs of concrete had been identified. As a result of this meeting PSI agreed to stop concrete activities for safety related structures, perform non-destructive examinations of various concrete structures, identify and evaluate repaired areas for adequacy and review their entire program for concrete activities onsite. An Immediate Action Letter (IAL) dated June 27, 1979, was issued confirming this agreement. — IAL 06-27-79

On June 27-29 and July 2-7, 1979, inspection was conducted relative to Items 1, 2, 3, 4 and 5 of the IAL. Based on the results of this inspection, Region III concurred in the resumption of concrete placement for safety related structures. One item of noncompliance was identified with regard to failure to assure purchased services conformed to procurement documents. — IE Inspection Report No. 79-07

Initial results of the inspection conducted during the period of July 9 through July 27, 1979 lead to a site management meeting on July 20, 1979, and an understanding that the licensee would again stop concrete activities for safety related structures. A second Immediate Action Letter (IAL) dated July 23, 1979, was issued documenting this understanding. Five items of noncompliance were identified with regard to: inadequate QC inspection, six examples; inadequate specification of quality requirements, four examples; lack of or failure to follow procedures, four examples; failure to take effective corrective actions, three examples; and lack of adequate training. — IAL 07-23-79, IE Inspection Report No. 79-09

On July 25, 1979, Region III learned that a team from the National Board of Boiler and Pressure Vessel Inspectors had conducted an inspection on June 12-14, 1979, at the Marble Hill site during which numerous items of noncompliance with the ASME Code were found. As of the result of the National Board's inspection and the Region III findings a comprehensive team inspection was conducted during the — IE Inspection Report No. 79-11

period of July 26-28, July 31-August 3, 1979. The purpose of this inspection was to identify the underlying causes leading to the concrete and ASME Code Deficiencies and to determine if they were symptomatic of problems in other areas. The results of this inspection indicated that problems and the Quality Assurance/Quality Control (QA/QC) program in concrete construction activities extended to other construction areas as well. Four items of noncompliance were identified: failure to sufficiently implement the QA program; failure of established measures to assure the conditions adverse quality were promptly identified and corrected; failure to assure the special processes, including welding...are controlled...by...qualified procedures; and failure to properly control materials...which do not conform to requirements.

2. NRC Actions

- NRC actions following the identification of problems relative to placement and repair of concrete and prior to this SALP evaluation period are described in Paragraph 1, Basis.

- Region III issued a second IAL Letter which confirmed that PSI would again stop concrete activities for safety-related structures. — 07-23-79

- As a result of findings prior to this evaluation period Region III conducted a comprehensive team inspection during the period of July 26-28, July 31-August 3, 1979. The results of this team inspection are as follows. — IE inspection Report No. 79-11

  NRC concluded that effective implementation of the documented Marble Hill Quality Assurance program for all safety-related construction had not occurred. PSI and their contractors had not sufficiently complied with its fundamental commitment to conduct all of these construction activities in accordance with the requirements of 10 CFR 50, Appendix B, and other required codes and standards.

  The principal causes of these adverse conditions and noncompliances were: (1) insufficient management and manage-

ment support, (2) insufficient number of personnel, (3) insufficient technical qualification of personnel, and (4) insufficiently experienced personnel.

The secondary but significant contributing causes were: (1) failure to adequately identify PSI's task or mission regarding the verification of the adequacy of work done by contractors, (2) failure to devise a system to comprehensively account for and evaluate all identified nonconformances occurring on the site, (3) failure to recognize the generic implications of recurring deficiencies, (4) failure to recognize that fixed price construction contracts, while not inherently defective, are likely to place heavier demands on the licensee verification of construction adequacy, (5) failure to delegate sufficient authority to QC inspectors and their managers regarding stop-work authority, (6) failure to institute employment (manning) and compensation practices which would attract adequately qualified and experienced job applicants, (7) failure of corporate management to recognize the need to be more responsive to site QA/QC manning request, (8) failure to be responsive to and recognize the importance and authority of construction code enforcement bodies, and (9) failure to recognize that the use and attempted upgrading of laborers to supplement unavailable journeyman craftsmen requires more comprehensive training and oversite.

The above findings by their nature involved all safety-related construction activity by PSI and their contractors at the site. Without extensive corrective actions, there was little likelyhood that continued construction could be accomplished with adequate assurance that quality requirements would be met.

At the request of PSI, representatives of Region III and PSI management met again on August 1, 1979, to discuss PSI's planned actions to correct the programmatic

IE Inspection Report No. 79-14, and Order 8-15-79

QA/QC problems at the Marble Hill site. Meeting included a discussion of the desirably of stopping all safety-related construction activities at the Marble Hill site until such time as the licensee demonstrates that it has an effective QA program acceptable to the NRC. The licensee issued a stopwork order on August 7, 1979, for all safety-related construction. An order confirming this suspension of construction was issued on August 15, 1979, by the NRC. A meeting was held with PSI management in the Region III offices on August 15, 1979, to discuss the conditions of the confirming order.

. Numerous management conferences were held during this evaulation period after the issuance of the order. these conferences occured on the following dates: 11-08-79, 12-10-79, 01-21-80, 02-20-80, 02-27-80, 03-31-80, 04-30-80, and 06-27-80. On 03-25-80 a public meeting was held in Madison, Indiana to discuss the licensees response to the August 15, 1979 "Order Confirming Suspension of Construction."	IE Inspection Reports No. 79-24, 79-28, 80-05, 80-07, 80-12, 80-17, 80-24.
. Upon issuance of the order an augmented inspection program to verify compliance with the order was initiated.	08-15-79
. A full-time senior resident inspector was assigned to the Marble Hill site.	12-03-79
. A formal briefing on resumption of construction of Marble Hill was presented to the NRC Commissioners.	05-07-80
. The Director of IE issued a document titled "Graduated Recission to the August 15, 1979 Order." This document prescribed a graduated rescission process for implementation at Marble Hill to assure that the licensee's corrective actions were implemented and effective. Construction activities at the Marble Hill site resumed in a graduated, step-wise fashion with review by the NRC at appropriate stages.	05-15-80

3. Licensee Corrective Actions

Licensee Corrective Actions relative to each Immediate Action Letter (IAL) are documented in the inspection reports referenced in Paragraph 1, Basis. The corrective actions relative to inspection findings that resulted in the issuance of the August 15, 1979 Order and those items identified in the Order are documented in virtually all of the inspection reports issued since that time and during this SALP evaluation period. In addition the following documents which are available in the local Public Document Room describe the licensees corrective actions:

- Report SL-3753, Evaluation of Inplace Concrete, Marble Hill Nuclear Generating Station Units 1 and 2, prepared for PSI by Sargent and Lundy Engineers, November 20, 1979. Revision 1, November 21, 1980.
- February 28, 1980, DISCRIPTION OF LICENSEE ACTIVITIES ADDRESSING ORDER CONFIRMING SUSPENSION OF CONSTRUCTION.
- April 28, 1980, CONSOLIDATED DESCRIPTION OF QUALITY ASSURANCE PROGRAM.
- September 12, 1980, CONSTRUCTION AND MATERIAL VERIFICATION PROGRAM, FINAL REPORT. REPORT REVISED May 15, 1981.

B. Contention

"The licensee had not sufficiently implemented Quality Assurance and Management Controls."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Actions

Major examples are the same as identified in Contention A.

C. Contention

"There were ineffective controls over civil and mechanical construction."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Actions

Major examples are the same as identified in Contention A.

D. Contention

"There were ineffective controls over stored equipment and components."

1. Basis

During an inspection on November 14-20, 1979, one item of noncompliance identified relative to failure to provide proper storage and maintenance of material with 19 examples. Six other items of noncompliance were identified during an inspection on January 7-31, 1980 with the following findings: failure to include quality storage requirements in procurement documents; failure to prescribe a quality storage activitiy in documented procedure; failure to adequately implement (verify conformance) a storage inspection program; failure to provide adequate storage/preservation instructions and to provide such instructions in timely manner; failure to adequately identify storage nonconformances; and failure to provide prompt corrective action for storage nonconformances.

IE Inspection Reports No. 79-25 and No. 80-03

2. NRC Actions

Same as identified in Contention A.

IE Inspection Report No. 80-43

3. Licensee Corrective Actions

The licensee developed an extensive material control program which was implemented subsequent to this SALP evaluation period.

E. Contention

"Quality Control inspections by contractor personnel were not performed effectively."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Actions

Major examples are the same as identified in Contention A.

F. Contention

"Conditions adverse to quality were not corrected prior to concrete placement."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Action

Major examples are the same as identified in Contention A.

G. Contention

"Corrective actions were not taken for discrepancies."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Actions

Major examples are the same as identified in Contention A.

H. Contention

"Marble Hill received a relatively large number of items of noncompliance when compared to other construction facilities under construction."

1. Basis

The number of items of noncompliance were high, however, in view of the fact that safety-related construction work was suspended by an NRC order for most of the appraisal period, there was no basis to	IE Inspection Report No. 80-45

compare the licensee's regulatory performance with other plants under construction. The majority of items of noncompliance dealt with activities in progress before work was suspended, except those discussed in Contention D.

2. NRC Actions

Same as identified in Contention A.

3. Licensee Corrective Action

Same as identified in Contention A.

I. Contention

"There were instances where the licensee required escalated NRC enforcement action, frequent management contacts, and stopwork orders to assure compliance with NRC requirements. An order suspending all safety-related was issued in August 1979, because of NRC concerns over the adequacy of the licensee's quality assurance program and controls over construction activities."

1. Basis

Major examples are the same as identified in Contention A.

2. NRC Actions

Major examples are the same as identified in Contention A.

3. Licensee Corrective Actions

Major examples are the same as identified in Contention A.