EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 22900
INSTRUMENTATION AND CONTROL DESIGN

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS SPECIAL PROGRAM

REPORT NUMBER: 22900

REPORT TYPE: SUBCATEGORY REPORT FOR ENGINEERING

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REASON FOR REVISION:

1. Revised to incorporate SRP, TAS, and TVA comments and latest element evaluation status.

2. Revised to incorporate CAPs for Elements 229.1, 229.2, and 229.11, and to incorporate additional SRP comments.

3. Revised to incorporate TAS comments and to add Attachment C (References) and Attachment D (Tables).

4. Revised to incorporate TAS and SRP comments on Rev. 3.

5. Revised to incorporate TAS comments on Rev. 4.

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EXECUTIVE SUMMARY

This subcategory report summarizes and evaluates the results of 29 Employee Concerns Special Program (ECSP) element evaluations prepared under Engineering Subcategory 22900, Instrumentation and Control Design. The evaluations document the review of 56 issues related to TVA's four nuclear plant sites, Sequoyah (SQN), Watts Bar (WBN), Browns Ferry (BFN), and Bellefonte (BLN). The issues were derived from a total of 20 employee concerns which cited presumed deficiencies or inadequacies in the design of instrumentation and control systems.

Of the 56 issues evaluated, 41 were found to require no corrective action. The remaining 15 issues resulted in 11 corrective actions, a single corrective action being able to accommodate several related issues. Four of the corrective actions were initiated by TVA before the Employee Concerns Task Group evaluations, five are new actions required to resolve the issues, six are actions required to resolve peripheral findings identified during the evaluations.

The conditions that led to the negative findings were diverse, with no single category of cause dominating. Only three of the 11 corrective actions for this subcategory were judged to be significant from a safety standpoint. These actions are:

- Perform loop accuracy calculations for SQN, WBN, BFN, and BLN to establish the effects of flow element measurement accuracy on plant safety parameters
- Modify the SQN auxiliary control air subsystem, which is safety related, to assure its availability under accident conditions
- Complete the installation of BFN postaccident radiation monitoring equipment to satisfy TMI action plan requirements

Although the employee concerns and issues examined in the course of the evaluations for this subcategory did identify some valid problems, the relatively small number of negative findings, the random nature of the most plausible causes, and the overall significance of the corrective actions cannot, in and of themselves, lead to the clear conclusion that instrumentation and control design constitutes a significant problem for the Sequoyah, Watts Bar, Browns Ferry, and Bellefonte nuclear power plants. Nevertheless, a justifiable inference can be drawn from the calculational and design discrepancies noted that the design review process should be improved.

The most reasonably derived causes identified herein are being compared with other evaluation results and examined from a wider perspective in the Engineering category evaluation.

Preface

This subcategory report is one of a series of reports prepared for the Employee Concerns Special Program (ECSP) of the Tennessee Valley Authority (TVA). The ECSP and the organization which carried out the program, the Employee Concerns Task Group (ECTG), were established by TVA's Manager of Nuclear Power to evaluate and report on those Office of Nuclear Power (ONP) employee concerns filed before February 1, 1986. Concerns filed after that date are handled by the ongoing ONP Employee Concerns Program (ECP).

The ECSP addressed over 5800 employee concerns. Each of the concerns was a formal, written description of a circumstance or circumstances that an employee thought was unsafe, unjust, inefficient, or inappropriate. The mission of the Employee Concerns Special Program was to thoroughly investigate all issues presented in the concerns and to report the results of those investigations in a form accessible to ONP employees, the NRC, and the general public. The results of these investigations are communicated by four levels of ECSP reports: element, subcategory, category, and final.

Element reports, the lowest reporting level, will be published only for those concerns directly affecting the restart of Sequoyah Nuclear Plant's reactor unit 2. An element consists of one or more closely related issues. An issue is a potential problem identified by ECTG during the evaluation process as having been raised in one or more concerns. For efficient handling, what appeared to be similar concerns were grouped into elements early in the program, but issue definitions emerged from the evaluation process itself. Consequently, some elements did include only one issue, but often the ECTG evaluation found more than one issue per element.

Subcategory reports summarize the evaluation of a number of elements. However, the subcategory report does more than collect element level evaluations. The subcategory level overview of element findings leads to an integration of information that cannot take place at the element level. This integration of information reveals the extent to which problems overlap more than one element and will therefore require corrective action for underlying causes not fully apparent at the element level.

To make the subcategory reports easier to understand, three items have been placed at the front of each report: a preface, a glossary of the terminology unique to ECSP reports, and a list of acronyms.

Additionally, at the end of each subcategory report will be a Subcategory Summary Table that includes the concern numbers; identifies other subcategories that share a concern; designates nuclear safety-related, safety significant, or non-safety related concerns; designates generic applicability; and briefly states each concern.

Either the Subcategory Summary Table or another attachment or a combination of the two will enable the reader to find the report section or sections in which the issue raised by the concern is evaluated.

The subcategories are themselves summarized in a series of eight category reports. Each category report reviews the major findings and collective significance of the subcategory reports in one of the following areas:

- management and personnel relations
- industrial safety
- construction
- material control
- operations
- quality assurance/quality control
- welding
- engineering

A separate report on employee concerns dealing with specific contentions of intimidation, harassment, and wrongdoing will be released by the TVA Office of the Inspector General.

Just as the subcategory reports integrate the information collected at the element level, the category reports integrate the information assembled in all the subcategory reports within the category, addressing particularly the underlying causes of those problems that run across more than one subcategory.

A final report will integrate and assess the information collected by all of the lower level reports prepared for the ECSP, including the Inspector General's report.

For more detail on the methods by which ECTG employee concerns were evaluated and reported, consult the Tennessee Valley Authority Employee Concerns Task Group Program Manual. The Manual spells out the program's objectives, scope, organization, and responsibilities. It also specifies the procedures that were followed in the investigation, reporting, and closeout of the issues raised by employee concerns.

ECSP GLOSSARY OF REPORT TERMS*

classification of evaluated issues the evaluation of an issue leads to one of the following determinations:

Class A: Issue cannot be verified as factual

Class B: Issue is factually accurate, but what is described is not a problem (i.e., not a condition requiring corrective action)

Class C: Issue is factual and identifies a problem, but corrective action for the problem was initiated before the evaluation of the issue was undertaken

Class D: Issue is factual and presents a problem for which corrective action has been, or is being, taken as a result of an evaluation

Class E: A problem, requiring corrective action, which was not identified by an employee concern, but was revealed during the ECTG evaluation of an issue raised by an employee concern.

collective significance an analysis which determines the importance and consequences of the findings in a particular ECSP report by putting those findings in the proper perspective.

concern (see "employee concern")

corrective action steps taken to fix specific deficiencies or discrepancies revealed by a negative finding and, when necessary, to correct causes in order to prevent recurrence.

criterion (plural: criteria) a basis for defining a performance, behavior, or quality which ONP imposes on itself (see also "requirement").

element or element report an optional level of ECSP report, below the subcategory level, that deals with one or more issues.

employee concern a formal, written description of a circumstance or circumstances that an employee thinks unsafe, unjust, inefficient or inappropriate; usually documented on a K-form or a form equivalent to the K-form.

evaluator(s) the individual(s) assigned the responsibility to assess a specific grouping of employee concerns.

findings includes both statements of fact and the judgments made about those facts during the evaluation process; negative findings require corrective action.

issue a potential problem, as interpreted by the ECTG during the evaluation process, raised in one or more concerns.

K-form (see "employee concern")

requirement a standard of performance, behavior, or quality on which an evaluation judgment or decision may be based.

root cause the underlying reason for a problem.

*Terms essential to the program but which require detailed definition have been defined in the ECTG Procedure Manual (e.g., generic, specific, nuclear safety-related, unreviewed safety-significant question).

Acronyms

AI	Administrative Instruction
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BFN	Browns Ferry Nuclear Plant
BLN	Bellefonte Nuclear Plant
CAQ	Condition Adverse to Quality
CAR	Corrective Action Report
CATD	Corrective Action Tracking Document
CCTS	Corporate Commitment Tracking System
CEG-H	Category Evaluation Group Head
CFR	Code of Federal Regulations
CI	Concerned Individual
CMTR	Certified Material Test Report
COC	Certificate of Conformance/Compliance
DCR	Design Change Request
DNC	Division of Nuclear Construction (see also NU CON)

DNE	Division of Nuclear Engineering
DNQA	Division of Nuclear Quality Assurance
DNT	Division of Nuclear Training
DOE	Department of Energy
DPO	Division Personnel Officer
DR	Discrepancy Report or Deviation Report
ECN	Engineering Change Notice
ECP	Employee Concerns Program
ECP-SR	Employee Concerns Program-Site Representative
ECSP	Employee Concerns Special Program
ECTG	Employee Concerns Task Group
EEOC	Equal Employment Opportunity Commission
EQ	Environmental Qualification
EMRT	Emergency Medical Response Team
EN DES	Engineering Design
ERT	Employee Response Team or Emergency Response Team
FCR	Field Change Request
FSAR	Final Safety Analysis Report
FY	Fiscal Year
GET	General Employee Training
HCI	Hazard Control Instruction
HVAC	Heating, Ventilating, Air Conditioning
II	Installation Instruction
INPO	Institute of Nuclear Power Operations
IRN	Inspection Rejection Notice

L/R	Labor Relations Staff
M&AI	Modifications and Additions Instruction
MI	Maintenance Instruction
MSPB	Merit Systems Protection Board
MT	Magnetic Particle Testing
NCR	Nonconforming Condition Report
NDE	Nondestructive Examination
NPP	Nuclear Performance Plan
NPS	Non-plant Specific or Nuclear Procedures System
NQAM	Nuclear Quality Assurance Manual
NRC	Nuclear Regulatory Commission
NSB	Nuclear Services Branch
NSRS	Nuclear Safety Review Staff
NU CON	Division of Nuclear Construction (obsolete abbreviation, see DNC)
NUMARC	Nuclear Utility Management and Resources Committee
OSHA	Occupational Safety and Health Administration (or Act)
ONP	Office of Nuclear Power
OWCP	Office of Workers Compensation Program
PHR	Personal History Record
PT	Liquid Penetrant Testing
QA	Quality Assurance
QAP	Quality Assurance Procedures
QC	Quality Control
QCI	Quality Control Instruction

QCP	Quality Control Procedure
QTC	Quality Technology Company
RIF	Reduction in Force
RT	Radiographic Testing
SQN	Sequoyah Nuclear Plant
SI	Surveillance Instruction
SOP	Standard Operating Procedure
SRP	Senior Review Panel
SWEC	Stone and Webster Engineering Corporation
TAS	Technical Assistance Staff
T&L	Trades and Labor
TVA	Tennessee Valley Authority
TVTLC	Tennessee Valley Trades and Labor Council
UT	Ultrasonic Testing
VT	Visual Testing
WBECSP	Watts Bar Employee Concern Special Program
WBN	Watts Bar Nuclear Plant
WR	Work Request or Work Rules
WP	Workplans

CONTENTS

TABLES

1. INTRODUCTION

This subcategory report summarizes and evaluates the results of the ECSP element evaluations performed under Engineering Subcategory 22900, Instrumentation and Control Design. Subcategory 22900 addresses employee concerns that cite perceived design deficiencies or inadequacies in a diverse group of instrumentation and control systems.

The employee concerns provide the basis for the element evaluations and are listed by element number in Attachment A. The plant location where each concern was originally identified and the applicability of the concern to other TVA nuclear plant sites are also shown.

The evaluations are summarized in the balance of this report as follows:

- Section 2 -- summarizes, by element, the issues stated or implied in the employee concerns.
- Section 3 -- outlines the process followed for the element and subcategory evaluations and cites documents reviewed.
- Section 4 -- provides the discussion, by element, that forms the basis of the evaluation findings, identifies the problems that must be resolved, and addresses determination of generic applicability.
- Section 5 -- highlights the corrective actions required for resolution of the negative findings cited in Section 4 and relates them to element and to plant site.
- Section 6 -- identifies causes of the negative findings.
- Section 7 -- assesses the significance of the negative findings.
- Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given, along with notation of any other element or category with which the concern is shared; the plant sites to which it could be applicable are noted; and the concern is quoted as received by TVA and characterized as safety related, not safety related, or safety significant.
- Attachment B -- contains a summary of the element-level evaluations. Each issue is listed by element number and plant opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 33 by using the CATD number which

appears in Attachment B in parentheses at the end of the corrective action description.

- Attachment C -- lists the references cited in the text.

- Attachment D -- lists in tabular form specific information relevant to certain elements. These tables are referred to in the text of Section 4, but their inclusion there would seriously undermine readability. Exceptions are Tables 1 and 2, which do appear in the text.

2. SUMMARY OF ISSUES

The employee concerns listed in Attachment A for each element and plant have been examined, and the potential problems raised by the 20 concerns have been identified as 56 separate issues. A summary of the 56 issues evaluated under this subcategory, grouped by element, appears below:

- 229.1, Calculation of Orifice Sizes - Flow element orifice plates are incorrectly sized; thus, measurement error can occur.

- 229.2, Panel Drains - Some panel drain piping which may carry radioactive liquid is routed to nonradioactive drainage systems.

- 229.3, Circulating Water - Instrumentation for monitoring flow to the river through the cooling water diffuser is inadequate.

- 229.5, Control Air System - The air volume of the control air system is not adequate in the event of an air line break.

- 229.6, Water Quality System - The water quality monitoring system is not designed to preclude radioactivity release under certain accident conditions.

- 229.8, Tank Level Switches - Inefficient manual control, as opposed to automatic control, is used for the chilled water system expansion tanks.

- 229.9, Acoustics Monitoring - Redundant data recorders are not provided for the acoustic monitoring system.

- 229.10, Mercury Switches - Mercury switches are inappropriately used in the Diesel Generator Building.

- 229.11, Radiation Monitoring - The quantity of radiation detection equipment is insufficient to meet federal guidelines.

- 229.12, Panel Instrument Distance - The distance between some control panels and the controlled equipment is too great.

The issue summaries above deal with presumed deficiencies or inadequacies in the design of the instrument and control systems. More specifically, three of the issue summaries are concerned with the quality of the design (229.1, 229.3, and 229.8), three others deal with the quantity of equipment provided (229.5, 229.9, and 229.11), and four of the issue summaries suggest errors or oversights in the design (229.2, 229.6, 229.10, and 229.12).

As the following sections show, five of the above issue summaries were found to be valid and require corrective actions (229.1, 229.2, 229.3, 229.10, and 229.11). Two of these involve design quality, one involves quantity of equipment, and the remaining two involve design errors. Additionally, of the six peripheral issues discovered, all requiring corrective action, (229.5, 229.9, and 229.11), four involve design control, one involves design error, and one involves timely resolution of issues.

Each issue evaluated within the element evaluations is stated fully in Attachment B, which also lists corresponding findings and corrective actions that are discussed in Sections 4 and 5 of this report.

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations prepared to address the specific employee concerns related to the issues broadly defined in Section 2. The evaluation process consisted of the following steps:

a. Defined the issues for each element from the employee concerns.

b. Reviewed current regulatory requirements, industry standards, and TVA criteria documents related to the issues to develop an understanding of the design basis.

c. Reviewed applicable design documents, purchase specifications, drawings, and calculations and conducted facility walkdowns, as appropriate, to develop design understanding and to verify implementation status.

d. Reviewed applicable Preliminary Safety Analysis Report (PSAR), Final Safety Analysis Report (FSAR), Safety Evaluation Report (SER), and SER Supplements to understand scope and basis of NRC review, to determine regulatory compliance, and to identify any open issues or TVA commitments related to the design.

e. Reviewed any other documents applicable to the issues and determined to be needed for the evaluation such as correspondence, procedures, test reports, Nonconforming Condition Reports (NCRs), Engineering Change Notices (ECNs), evaluation reports, etc.

f. Witnessed system operation to validate issues presented.

g. Interviewed TVA corporate and site personnel in person and by phone to develop understanding of problems noted.

h. Discussed component problems with supplier (vendor) representatives.

4. FINDINGS/GENERIC APPLICABILITY

A summary of the findings for each element and the rationale for generic applicability determination are presented in Section 4.1. A summary of findings grouped at the subcategory level is contained in Section 4.2. Subsections 4.3 through 4.12 contain a detailed discussion of each element.

4.1 Summary of Element Findings

The findings for each element are summarized below.

4.1.1 Calculation of Orifice Sizes - Element 229.1

Independent calculations performed by the evaluation team established that the margin of error introduced by TVA orifice sizing techniques is acceptable for those applications where only qualitative flow information is required. Whether these methods are adequate for flow measuring applications where more precise quantitative information is necessary, such as control or safety applications, depends upon deeper systems analysis. In this area, the evaluation team found that TVA had not complied with its own criteria in establishing or verifying instrument loop accuracies sufficient to prevent encroachment on safety margins.. Initially, review of this concern was to be restricted to WBN, where the concern was raised, and to SQN, because the Meriam Instrument Company (Meriam) orifice plates in question were used there too. However, this peripheral finding detected in the initial reviews was so generic in nature that BFN and BLN were evaluated as well.

4.1.2 Panel Drains - Element 229.2

The concern correctly stated a condition wherein potentially radioactive inventory can be delivered to open floor drains. The content of this concern and the ALARA issues it presented raised it to the generic level to be addressed for all TVA nuclear units. Even though the evaluation team found inconsistencies in the various design and licensing documents peripherally related to this issue, no violations of criteria could be established. Therefore, while the concern is correct, several mitigating factors, outlined in Subsection 4.4 of this report, produced a judgment that corrective actions are not necessary for SQN, WBN, and BLN. However, several discrepancies between installed hardware and design and licensing documents were noted for BFN. BFN will complete the identified hardware modifications to assure that exposure to personnel is maintained as low as reasonably achievable (ALARA).

4.1.3 Circulating Water - Element 229.3

The concern correctly outlined problems related to the instrumentation for monitoring flow to the river at WBN. The instrumentation application and the circumstances surrounding the concern were unique to WBN; therefore it was not reviewed at BFN, BLN, or SQN. Without corrective action, the flow measurement was ineffective. Proper measurement is required to provide a means of assuring proper dilution of infrequent discharges of low level radioactive waste and for assuring compliance with the WBN National Pollutant Discharge Elimination System permit to avoid violation of thermal or chemical discharge standards. The problems identified had corrective action in progress prior to the ECTG evaluation. No additional corrective actions are required.

4.1.4 Control Air System - Element 229.5

The concern addressed control air system (CAS) reserve capacity in the event the system is damaged by a postulated event: a guillotine pipe break in the CAS. A guillotine pipe break in the CAS is not a design basis event for any of the plants reviewed. However, the NRC mandated review of potential high energy line breaks on SQN revealed a potential for unacceptable interactions with the CAS that could lead to loss of control air. This, in turn, could preclude the occurrence of certain actions required for safe shutdown. This situation was overlooked in the original systems analysis, which was performed to validate the CAS design. Hardware changes to the CAS have been identified and will ensure availability of the CAS during credible accident conditions. No potential for similar interactions was found for WBN and BLN. The issue was not examined at BFN because a safety grade control air system is not used at that plant.

4.1.5 Water Quality System - Element 229.6

Although the design of the water quality monitoring system for both SQN and WBN allows the piping to contain radioactive material during certain operating conditions, the design limits personnel exposure to less than permitted by the regulations. This system is unique to the WBN and SQN designs and was not addressed at BFN or BLN.

4.1.6 Tank Level Switches - Element 229.8

Controls for replenishing inventory to the chilled water expansion tanks at SQN and WBN were evaluated. While improvements could be made, the evaluation team could not establish that such improvements were warranted. The existing controls were found to be acceptable. The concern was specific to systems at WBN and SQN only and did not present generic issues for evaluation at BLN or BFN.

4.1.7 Acoustics Monitoring - Element 229.9

The evaluation team established that TVA criteria do not define the acoustic monitoring system as safety related, and, therefore, redundant recorders are not required. However, the WBN evaluation did reveal some discrepancies in the documentation of the system and a CATD was initiated to resolve these items.

4.1.8 Mercury Switches - Element 229.10

The evaluations revealed that TVA design standards do restrict the use of mercury switches in the Diesel Generator Building. At SQN where limited use of mercury switches was found, adequate justification has been provided. However, mercury switches have been used for BFN without documentation to substantiate that their use is acceptable in the application. In the judgment of the evaluation team, the use of these mercury switches should be acceptable, but a documented evaluation must be provided to assure this acceptability in accordance with TVA criteria. The concern presented a generic issue regarding TVA's general compliance with its own standards on mercury switch usage.

4.1.9 Radiation Monitoring - Element 229.11

Except for certain radiation detection equipment currently being installed at BFN to meet post-TMI radiation monitoring requirements, all plants evaluated were found to have a sufficient quantity of radiation detection equipment to meet Federal guidelines. Documentation discrepancies needing correction were found for SQN, WBN, BFN, and BLN. Some of these discrepancies have caused licensing issues to remain open at this writing. The concern raised issues challenging TVA's general compliance with NUREG 0737 and its supplements, an issue generic to all TVA nuclear plants.

4.1.10 Panel Instrument Distance - Element 229.12

The concern expressed a general design condition generic to all TVA nuclear plants. The evaluations for SQN, WBN, BFN, and BLN concluded that the distance between control panels, sensors, and controlled equipment is consistent with industry practice and is acceptable but contingent upon proper installation.

4.2 Summary of Subcategory Findings

The classified findings are summarized in Table 1. Class A and B findings indicate there is no problem and that corrective action is not required. Class C, D, and E findings require corrective actions. The corrective action class, defined in the Glossary Supplement, is identified in the table by the numeral combined with the finding class. For example, the designation D1 in Table 1 indicates that the evaluated issue was found to be valid (finding Class D) and that a corrective action involving some type of hardware or plant modification is required (corrective action Class 1).

TABLE 1
CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
229.1	Calculation of Orifice Sizes	a	A	A	A	A
		b	D5	D5	D5	C5
		c	-	-	A	C5
229.2	Panel Drains	a	B	B	D1	B
		b	-	B	-	-
		c	-	A	-	-
229.3	Circulating Water	a	-	C1	-	-
229.5	Control Air System	a	A	B	-	A
		b	E1	-	-	-
229.6	Water Quality System	a	B	B	-	-
		b	A	A	-	-
229.8	Tank Level Switches	a	A	A	-	-
229.9	Acoustics Monitoring	a	-	A	-	-
		b	-	E3	-	-
229.10	Mercury Switches	a	A	B	D6	A
229.11	Radiation Monitoring	a	A	A	C1	A
		b	A	E3	E7	E3
		c	A	-	-	-
		d	E3	-	-	-
		e	B	-	-	-
229.12	Panel Instrument Distance	a	A	A	A	A
		b	A	A	A	A
		c	A	A	A	A

*Classification of Findings and Corrective Actions

A. Issue not valid. No corrective action required.
B. Issue valid but consequences acceptable. No corrective action required.
C. Issue valid. Corrective action initiated before ECTG evaluation.
D. Issue valid. Corrective action taken as a result of ECTG evaluation.
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.

1. Hardware
2. Procedure
3. Documentation
4. Training
5. Analysis
6. Evaluation
7. Other

**Defined for each plant in Attachment B.

Findings are summarized by classification in Table 2. Of the 56 findings identified by a classification in Table 1, 41 require no corrective action. The remaining 15 findings resulted in 11 corrective actions. Four of these findings had corrective actions initiated before the ECTG evaluation, five required new corrective actions to be identified, and six findings resulted from peripheral findings uncovered during the ECTG evaluation. From this table it can be seen that at Watts Bar, where most of the issues were originated, two out of the original 15 issues (peripheral findings not included) were found to be valid and require corrective action, and one of these two issues had corrective action initiated before the ECTG evaluation.

The bases for the findings summarized above are discussed in the following subsections.

It should be noted that substantial data were collected and reduced to derive and support the following discussions of each element. These data are presented in tabular form at the end of this report and not in the main text itself to enhance readability. The only tables presented in the main text are those solely germane to the subcategory itself.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant: SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	11	9	5	7	32
B. Issue valid but consequences acceptable. No corrective action required.	3	5	0	1	9
C. Issue valid. Corrective action initiated before ECTG evaluation.	0	1	1	2	4
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	1	1	3	0	5
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	2	2	1	1	6
Total	17	18	10	11	56

4.3 Calculation of Orifice Sizes - Element 229.1

4.3.1 Overview

Concern PH-85-022-001 was raised in 06/85 with specific reference to Watts Bar Contract 85320-1 with Meriam. It dealt with theoretical differences in calculating the required bore size of flow measuring orifice plates.

Concern NS-85-004-001 was also raised at WBN, in 08/85, with reference to incorrect bore size. It suggested that the issue could also be a problem at SQN but did not mention BFN or BLN. It did not stipulate the source of the "incorrect hole size" problems. However, as a result of file research and personnel interviews, the SQN evaluation team concluded that concern NS-85-004-001 was based on differences in calculational methods and not on such peripheral findings as manufacturing tolerance errors undetected by the receiving inspection. Since such calculational methods are generic to all plants, the concern is applicable to all plants. The following evaluation proceeds on this basis.

Both concerns PH-85-022-001 and NS-85-004-001 were thoroughly investigated for WBN by the Nuclear Safety Review Staff (NSRS), which documented its investigation in Report I-85-525-WBN (Ref. 1) on 12/17/85. This report raised the issue of the applicability of the orifice hole sizing methodology for Post Accident Monitoring (PAM) functions. This investigation was followed by a June 1986 Generic Concerns Task Force (GCTF) investigation on SQN that largely depended upon and concurred with the NSRS investigation at WBN (Ref. 2).

4.3.2 Definitions and Terminology

The term "false," as used in Concern NS-85-004-001, is interpreted by the evaluator as a statement of relative accuracy. This is in contrast to the more normal usage which is to convey an entirely misleading, erroneous, untrue, or wrong message. In the present case, a flow indication is considered "false" only if it is so inaccurate as to cause the plant operator or control device to take an inappropriate control action.

4.3.3 Previous Investigations

The SQN GCTF investigation dealt with an additional programmatic concern (IN-85-293-001) regarding documented closeout of WBN NCR 4412R. This NCR dealt with an orifice plate beta ratio (d/D) near the upper level of acceptable tolerance. While the Meriam orifice plates in question were replaced at WBN, the SQN GCTF investigation did not find that the changes were technically necessary. In reporting the basis for these changes to the NRC, TVA pointed out that "although EN DES felt that the orifice plates were sufficient for the (WBN) system design, rather than expending time, money, and effort to verify the accuracy, it would be more cost-effective to purchase new plates." The SQN investigation did conclude that Meriam orifice plates were used at SQN.

The NSRS investigation at WBN (I-85-525-WBN) provided a well-balanced and technically supportable conclusion that the orifice plates in question "will perform their intended design function." This conclusion was limited to flow signals that did not involve postaccident monitoring (PAM). For PAM flow signals the NSRS report went on to say:

> "...overall acceptability of those plates providing signals to the PAM system was considered indeterminate pending a documented design evaluation to ensure they will perform within the accuracies assumed in the design calculations."

4.3.4 Industry Practices

A review of industry flow metering practices was conducted (Refs. 3 through 7). This review drew conclusions that were then applied to the analyses on each plant. From the review, the evaluators were able to derive some general industry guidelines as to when precise flow measurements are necessary and when still accurate but less precise applications are acceptable. It seems usually accepted practice that whether an orifice plate (and the care taken in its sizing, installation, and subsequent maintenance) constitutes a proper flow metering application depends on process conditions (flow velocity, acceptable head loss, etc.), the medium being measured (e.g., water, gas, oil, steam, etc.), and the end use of the flow signal. Orifice plates are acceptable metering devices for subcooled water of reasonable purity when a ratio of orifice plate bore to pipe diameter (d/D or "beta ratio") between 0.1 and 0.7 will produce the desired differential pressure. The ratio of inertial forces to viscous forces, commonly called the "Reynolds Number," is another key factor limiting the application of these flow elements. Minimum Reynolds Numbers above 10,000 for small lines and 500,000 for larger lines, and maximum Reynolds Numbers of about 1,000,000 in all lines, generally establish the domain for successful applications. Beyond these beta ratios and Reynolds Numbers, these flow elements suffer substantial decreases in accuracy.

Where the signal use is for vernier control of level or fluid flow, as is the case for precise mixing or close tolerances of liquid level, "precise" (i.e., derived from formulae containing Reynolds Number correction factors) designed orifice plates are more suitable than "plant" (i.e., derived from tables containing no correction factors) designed plates. The quantitative value of the flow being measured is very important in such applications. However, where more qualitative fluid flow information is acceptable, "plant" designed orifice plates are quite proper. Such qualitative applications are found where the fluid flow is measured only to establish maximum or minimum limits (e.g., alarm annunciation, equipment operation) or where the flow inventory is secondary to the variable of real interest, such as tank level or temperature differential. Most of the orifice plate flow signals are used in limit-setting applications to initiate alarms or stop/start equipment. Typically, these flow switch applications do not require precise accuracy. Where orifice plates are used to indicate flow, the measurement is more for qualitative than for precise quantitative information. In many cases flow is not the primary variable of interest. For example, heater drain flow is indicated, but system temperatures and levels are the variables of primary interest. (This distinction of "primary variable" applies to instances where the measured and the controlled variables are the same, as in steam generator level control.) Whether a qualitative reading is acceptable or the required accuracy of a quantitative signal is necessary, is, therefore, closely tied to the design purpose of the system and the use of the flow reading.

4.3.5 TVA Design Guidance

Electrical Design Standard DS-E18.1.10, "Instrument Set Points and Limits" (Ref. 8), deals especially with the issue of instrumentation accuracy for safety-related systems. DS-E18.1.10 was originally issued on 11/21/83, but its stated applicability is "to all nuclear power generating stations." Standard DS-E18.1.10 defines accuracy as "the degree of conformity of an indicated value to a recognized accepted standard value, or ideal value."

The definition of accuracy is expanded in DS-E18.3.6 (Ref. 9) and elaborated on by saying:

> "The degree of conformity of an indicated value to a recognized standard value, or ideal value; e.g., an accuracy of ± 10 psig means that for an actual value of 100 psig, indication can range from 90 to 110 psig."

Within the overall accuracy of the instrumentation system, certain errors due to the physical properties of the sensed medium must be factored in. These "process measurement errors" are defined in DS-E18.1.10 as:

> "Process errors that include those inherent in the measurement technique, for example the fluid stratification effects on temperature measurements, or the effect of fluid density changes on level measurement."

These definitions and standards are consistent with and derived from industry practices (Refs. 3 through 7). Section 5 of DS-E18.1.10 clearly draws a relationship between required accuracy and system design in stating that:

> "Required accuracy is that accuracy necessary to ensure that the safety limit is not exceeded by any operational transient or design basis event for which the instrument loop is required to function. The accuracy calculations must consider all sources of inaccuracy."

From this statement, it is clear that quantitative accuracies are necessary where safety limits are involved. Presumably where safety limits are not involved, the less accurate qualitative approach is acceptable. This practice is common in the industry, the only exceptions being control applications, where the sensed and the controlled variables are the same. In these cases, TVA, like all other process designers, would use the measurement accuracy necessitated by the control application. Such usage is standard design common knowledge and need not be documented in design standards. With this guidance, the evaluation team focused on identifying systems and applications that could have safety limits and on determining whether they could be exceeded by these flow elements.

4.3.6 SQN and WBN Evaluations

Because of the similarities in plant designs, and the fact that the orifices in question were purchased for both SQN and WBN under the same contract, the employee concern evaluations were basically the same. They are both discussed below.

The NSRS investigation of WBN listed all systems containing Meriam orifice plates. This listing, as presented in NSRS Investigation Report I-85-525-WBN, is:

"Component Cooling System (70)
Essential Raw Cooling Water (67)
Heater Drains (6)
Raw Cooling Water (24)
Waste Disposal (77)
Main Steam (1)
Feedwater (3)
High Pressure Fire Protection (26)
Demineralized Water (59)
Water Treatment (28)
Condensate (2)"

The parenthetical is the system number.

The evaluation team reviewed the complete SQN and WBN Instrument Tabulation (Refs. 10 and 23), and identified all in-line flow elements for both plants. The Meriam orifice plate elements were separated from the other types of flow elements (e.g., venturi nozzles). From this information, the SQN and WBN systems using Meriam orifice plates were easily identified.

With the systems identified, the evaluation team reviewed the FSARs (Refs. 11 and 24), and each system's control diagrams (Refs. 12 and 25), logic diagrams (Refs. 13 and 26), flow diagrams (Refs. 14, 15, and 27), design criteria (Ref. 16), and design guides (Refs. 17 and 28) to identify the use of the signal developed by each Meriam orifice plate flow instrument. A total of 139 SQN and 184 WBN flow elements was reviewed. No instances were found where flow was the primary variable and the flow signal was used for modulating control.

At both SQN and WBN, orifice plate flow elements FE-3-142 A, B, and C generate signals to the auxiliary feedwater pump/turbine flow control system. However, review of the main steam and feedwater systems drawings, design criteria, design guides, and FSAR descriptions shows that these flow elements are used to limit feedwater pump/turbine maximum speed and not to modulate flow control or establish steam generator level.

In the process of these reviews discrepancies between the various design documents were noted. For example, on WBN flow elements FE-70-110, FE-70-202, FE-70-203, and FE-70-204 were identified as not being listed in the WBN instrument tabulation, 47B601-70 series. These discrepancies were incidental to the purpose of this review and no CATD's were written since the total scope of the corrective actions in Subcategory 20600 covers reconciliation of documentation with as-built condition.

WBN flow elements FE-67-222 and FE-67-226, which were supplied by Daniel Industries under contract 84KK7-833960 (Ref. 56), were identified as having used an incorrect pipe internal diameter. The I.D. difference, 23.5 inches vs the actual 23.25 inches, results in less than a 1 percent error in the bore size. The Daniel Industries calculation (Ref. 256) also used the "plant" method of calculating bore size. The resultant errors were within the 5 percent accuracy specified by the TVA data sheet, and the orifices were accepted and installed.

Of the flow elements reviewed, only the limit-setting auxiliary feedwater pump flow signal mentioned above and those flow signals in safety systems used for PAM qualified for closer examination and compliance with TVA Design Standard DS-E18.1.10 (Ref. 8).

Postaccident Monitoring (PAM) Orifices

As a result of the Three Mile Island (TMI) accident, the Nuclear Regulatory Commission issued NUREG-0737 (Ref. 35) and Regulatory Guide (RG) 1.97 (Ref. 18) to identify the instrumentation required for plants to assess plant and environs conditions after an accident. Both documents were required to be backfitted to all operating plants. Compliance with RG 1.97 for WBN was found in a TVA letter to NRC (Ref. 36). The evaluators used Regulatory Guide 1.97 to identify the typical PAM variables. Regulatory Guide 1.97 identifies the following flow variables as "Type D," which is required to indicate the operations of individual safety systems and other systems important to safety:

- Residual Heat Removal (RHR) System Flow
- Safety Injection (SI) Boric Acid Charging Flow
- Flow in High Pressure Injection (HPI) System
- Flow in Low Pressure Injection (LPI) System
- Main Feedwater Flow
- Auxiliary Feedwater Flow
- Containment Spray Flow
- Chemical Volume Control System (CVCS) Makeup Flow In
- CVCS Letdown Flow Out
- Component Cooling Water (CCW) Flow to Emergency Safety Features (ESF) System

In each case, Regulatory Guide 1.97 establishes the required flow range as being from "0 to 110% of the maximum flow anticipated during operation"; no specific accuracy requirements are stated. The stipulated purpose of each flow signal is "to monitor operation" of the safety system. This is a qualitative purpose, to be contrasted with a more quantitative purpose such as controlling or metering flow. A flow indication for a qualitative purpose does not directly cause a safety limit to be exceeded, and, therefore, the qualitative application of the flow signal stipulated in Regulatory Guide 1.97 should make the "plant" calculational method acceptable. Nevertheless, the accuracy statements of DS-E18.1.10, which tie the flow element accuracy to a systems requirement that "the safety limit is not exceeded by any operational transient or design basis event for which the instrument loop is required to function," were applied to these PAM flow signals.

Analyses of the safety systems and numerical development of safety limits, followed by an assessment of total instrumentation loop accuracy, would be necessary to determine if the flow element sizing calculational methods are sufficient to support TVA design criteria. Such a design verification program goes well beyond the scope of the ECTG charter. However, without such a review the EC validity cannot be directly or conclusively resolved. The evaluation team was informed of a loop accuracy verification program now in progress at TVA that was already addressing this work. To avoid duplication of effort, the evaluation team used the following approach.

1. All PAM variables using orifice plates to generate their signals were identified. The auxiliary feedwater flow signal from FE 3-142 would be included in this list.

2. The actual Meriam "plant" sizing calculations for these flow elements were verified, and the key parameters selected to establish uncompensated flow at the full scale differential pressure specified.

3. Bechtel entered the key parameters used by Meriam into computer programs that employ the "precise" calculational method to establish compensated flow at the same differential (Tables 4, 5, and 6, Attachment D).

4. The flow differences between the verified "Meriam/Plant" and "Bechtel/Precise" calculations were then used to assess the significance to system operation.

5. Bechtel also reviewed TVA loop accuracy calculations for FE-3-142, the only control variable using an orifice plate, to determine the significance of flow element sizing accuracy differences in relation to other accuracies in the calculation.

SQN calculation SQN-SQS4-0066 (Table 7, Attachment D; Ref. 19) identified the flow indications intended for SQN compliance with Regulatory Guide 1.97.

Review of the system flow diagrams identified the flow element tag numbers. These were then compared with the Meriam contract and only the variables identified below have their signals generated by an orifice plate. For WBN, the same four orifices were identified. The "Bechtel/Precise" calculations produced the following results:

Flow Element	Diff. Pres. (WC)	Pipe I.D. (inches)	Beta Ratio	Bore Diam. (inches)	Plant Calc. (GPM)	"Precise" Calc. (GPM)	Diff. (%)
FE-3-142	300	5.501	0.691305	3.8029	1,000	973	2.68
FE-67-61 FE-67-62	200	29.250	0.653670	19.1198	20,000	19,502	2.49
FE-70-81B	100	3.068	0.719836	2.2085	200	195	2.58

The calculational derivation of these results is presented in Tables 4, 5, and 6, Attachment D. The programs used have been verified, and the source program is on file. Complete information regarding these calculations can be found in documentation supporting SQN element report 229.01 (Ref. 20).

It was noticed in the calculations for FE-67-61 and 62 that the Reynolds Number boundary conditions established for use of the "precise" calculations were not adhered to by Meriam. The Reynolds Number of 2,691,312 used in the calculation is well beyond the limit (approximately 1,000,000) where Reynolds Number corrections are meaningful.

With the above data, the evaluation team reviewed SQN Demonstrated Accuracy Calculation for 1,2-FT-3-142 (Ref. 21). The flow element section of this calculation has two accuracy factors listed, "Repeatability Error" and "Process Error." Their sources were not identified in the calculation. In telephone conferences with TVA personnel, regarding the SQN calculation (Ref. 22) and expanded upon later in assessing a WBN calculation (Ref. 29), it was established that neither factor accounted for error in establishing beta ratio. The "Repeatability Error" was intended to accommodate long-term changes in the element itself (wear, sludge buildup, etc.). The "Process Error" was to accommodate process-induced changes in fluid temperature, pressure, etc., over the operating range of the auxiliary feedwater system.

The Repeatability Error was based upon empirical data provided by different manufacturers. No documentation currently exists to support this factor, which is currently estimated as "± 2% of range." The process error is derived from known changes in the auxiliary feedwater system and is established as "± 1% of reading." The only point of intersection between the "range" and the "reading" errors is presumably at full scale. This point correlates with the flow element sizing errors at the full differential outlined above. However, because the TVA instrument loop accuracy calculations for FT-3-142 did not accommodate flow element sizing error, they should be revised to include an appropriate factor to accommodate flow element sizing error. It was determined that a TVA Loop Accuracy Verification Program is now in progress in response to Policy Memorandum PM86-02 (EEB), (Ref. 53). A completion date before fuel load was expected for all WBN calculations, including the FT-3-142 auxiliary feedwater flow element loop. This program is still in progress for SQN at this writing but a satisfactory review of the four orifices identified above was conducted to allow the loop accuracy program to be completed after SQN restart.

In the case of FT-3-142, the inaccuracy resulting from the two sizing methods will be between 20 and 30 gpm. On the basis of design and operating experience, the evaluation team does not believe that this error would oroduce pump runout or turbine overspeed trip as a result of excessive feedwater flow to a damaged steam generator. A numerically based systems analysis to support this judgment has not been performed and is beyond the scope of the ECTG program.

The purpose of FE-70-818, FE-67-61, and FE-67-62 is to monitor system operation per Regulatory Guide 1.97. This purpose is qualitative and would not be affected by the 2.0 to 3.0 percent level of error predicted on the basis of Bechtel calculations for similar installations. Detailed systems operational analyses would be necessary to prove this judgment conclusively. In no case do the error margins involved violate any regulatory criteria or FSAR statements.

Summary of SQN and WBN Evaluations

On these bases, the concern was considered to be factual to the extent potential errors due to using the "plant" sizing method were not considered in the accuracy calculations for flow parameters deemed critical to system design purpose. Of the 139 SQN and 184 WBN orifice plate applications reviewed, only four were judged to have functions that were sufficiently quantitative to warrant consideration of "precise" accuracy sizing calculations. In the opinion of the evaluation team, the calculated error of 2 percent to 3 percent should be acceptable for the design purposes intended contingent upon verification of overall loop accuracy under the programs presently in progress. A program that determines the instrument loop accuracy requirements, including proper sizing by the manufacturer, is now in progress at TVA. This program will evaluate the "plant" vs "precise" accuracy differences, along with other factors, to determine whether the total loop accuracy is proper for the application intended.

4.3.7 BFN Evaluation

The evaluation team reviewed the BFN Instrument Tabulation (Ref. 30) and identified all in-line flow elements and the contract under which they were supplied. Each flow element uniquely identifies the system to which it belongs by the first set of numbers on its tag (e.g., FE-73-33 is item 33 in system 73, high pressure coolant injection).

With the BFN systems identified, the evaluation team reviewed the FSAR (Ref. 31) and each system's control diagram (Ref. 32), logic diagram (Ref. 33), flow diagram (Ref. 31), and design guide (Ref. 34) to identify the use of the signal developed by each orifice plate flow instrument. The flow elements which require quantitative flow values were separated from those for which qualitative values are acceptable. The "quantitative" flow elements (i.e., those elements used for control functions) were added to the flow elements required for Regulatory Guide 1.97 PAM functions. A total of 200 BFN flow elements were reviewed and their related systems use evaluated for an assessment of proper application engineering.

These data are presented in Table 8, Attachment D. Instances were found where flow was the primary variable, and the flow signal was used for modulating control. However, a majority of the orifice plate flow signals are used in limit-setting applications to initiate alarms or stop/start equipment. As noted before, these flow switch applications typically do not require precise accuracy. The accuracy statements of DS-E18.1.10 were not applied to these flow signals.

Meriam Orifices

The concern about the use of Meriam Instrument orifices was specifically addressed by identifying and separately evaluating those orifices supplied by Meriam. From the instrument tabulation, a list of all the flow element contract numbers was compiled. These contracts were then searched to identify the vendors (Ref. 37). A review of the vendors for the flow elements indicated that Meriam supplied only FE-69-101, a restriction orifice in the nonsafety RWCU system. The use of the "plant" method for sizing this orifice is acceptable since only qualitative flow accuracy is needed. It was noted that flow diagram 47W810-1 for the RWCU system indicated that FE-69-101 was applicable to only BFN units 1 and 2; however, Meriam orifices were ordered for all three units.

Postaccident Monitoring (PAM) Orifices

As in the SQN and WBN evaluations, the criteria established in Regulatory Guide 1.97 were used to assess the flow variables required for post accident monitoring. These data are presented in Table 9, Attachment D. Table 10, Attachment D, presents a matrix of BFN flow elements used for safety, PAM, and control purposes. The 34 safety grade flow elements found were supplied as part of contracts with General Electric Co. (GE). GE appears to have subcontracted to various vendors including Daniel Industries and Vickery Simms, Inc., but not to Meriam. The combination of the complexity of the contract and the fact that it was executed when there were fewer requirements for providing backup documentation resulted in a lack of information for most of the flow elements.

To obtain orifice data, a review of existing walkdown data was conducted (Ref. 38). The results determined that data are only available for FE-84-19, 20. In addition, a new walkdown was initiated for FE-3-20 (Ref. 39). This too was not successful. The major reasons for the lack of available data from walkdowns are that orifice paddles, if they exist, are obscured by insulation and lagging, or orifice paddles or flow element nameplates do not exist.

In view of the lack of available data to identify flow elements, a request was made to a GE representative to review the Contract Data Files at the BFN site for selected flow elements (Ref. 40). Three sets of flow elements were found to be venturi nozzles: FE-1-13,25,36,50; FE-3-6,13,20; and FE-3-78A,B. The GE specifications (Refs. 257, 258, and 259) for the sample elements were found to include accuracy requirements of between 1 and 2.5 percent. It also was found that GE had combined the BFN procurement process with that of several other boiling water reactors (BWRs), thus standardizing components and suppliers. For the FE-71-36 orifice, vendor drawings and empirical calibration curves were found; however, the vendor design calculation, documenting the basis for the orifice hole size as required by the contract, was not in the contract files. The GE representative assumed it to be in the GE files in San Jose, CA, as GE was the purchasing agent.

Nonsafety-Related Orifices

Nonsafety-related orifices used for control were also evaluated case-by-case to determine the need for the "precise" method of orifice hole sizing. All were found to be acceptable as designed.

Loop Accuracy Calculations

Of the 200 BFN flow elements applications reviewed, only nine flow elements in five systems were considered to have functions that were sufficiently quantitative to warrant consideration of "precise" accuracy sizing calculations. These nine flow elements are being reviewed in a program for verifying loop accuracy calculations, now in progress at TVA.

These loop accuracy calculations have not been completed at this time. Because of the lack of orifice sizing documentation, the loop accuracy verification program has found it necessary to acquire BFN orifice data via a walkdown and reading of the information stamped on the "paddle" of the orifice. Using these data, TVA recalculated the orifice bore using the "precise" method. The differences between this TVA recalculated bore size and the actual bore size were found to be small. However, these differences were not included as an inaccuracy in a draft of the BFN loop accuracy calculations supplied to the ECTG evaluation team (Ref. 41). These "draft" calculations were considered preliminary and discussion with the calculation author indicated an intention to include these inaccuracies in the final calculation. The author also stated that when completed, the calculated loop accuracy will be compared with a safety limit as required by DS-E18.1.10 (Ref. 41).

Examples of comparisons of loop accuracies with the appropriate safety limits from previous I&C scaling and setpoint calculations (Ref. 42) were reviewed to identify the safety limits and the typical comparison process. A similar process should be acceptable for the final loop accuracy calculations. These data are presented in Table 11, Attachment D.

Summary of BFN Evaluation

On the basis of the above reviews, the evaluators found that the concerns as applied to BFN were factual to the extent that potential errors that could be caused by using the "plant" sizing method were not considered in the accuracy calculations for flow parameters considered to be critical to the system design purpose.

However, an existing program is in place to complete the loop accuracy calculations, and the intention to include the design inaccuracy errors from the "plant" sizing method has been expressed. The concern about Meriam specific orifices was found to be minor for BFN since there is only one Meriam orifice and the "plant" sizing method accuracy would be acceptable for this noncritical RWCU restriction orifice. The extent of the potential impact of the use of the "plant" sizing method on the 200 BFN flow elements reviewed has been limited to nine flow elements in five systems which are used for quantitative or safety-related functions. These nine flow elements are being reviewed in the loop accuracy calculations as indicated above. The remaining orifices were determined to perform nonsafety or noncontrol-related functions such that the increased accuracy of the "precise" sizing method over the "plant" method would not be necessary for the orifices to perform their functions. Thus these orifices would not be generating "false" signals by the definition in Subsection 4.3.2.

4.3.8 BLN Evaluation

The BLN review was conducted similarly to those for WBN and SQN. The plant systems identified in NSRS report I-85-525-WBN were used as an initial list of systems containing orifices. To obtain a complete list of orifices, the BLN Instrument Tabulations (Ref. 43) were reviewed.

The orifice vendors' contract numbers were identified from the instrument tabulations to determine if Meriam was an orifice supplier. The vendor list is included in Table 13, Attachment D. A RIMS data base search failed to find a BLN entry for Meriam orifices.

The evaluation team reviewed the FSAR (Ref. 44) and each system's logic control diagram (Ref. 45), flow diagram (Ref. 46), and design guide (Ref. 47) to identify the use of the signal developed by each orifice plate flow instrument. These data are presented in Table 12, Attachment D. BLN had 293 flow elements where related systems use was assessed. No instances were found where flow was the primary variable and the flow signal was used for modulating control. Most of the orifice plate flow signals are used in limit-setting applications to initiate alarms or stop/start equipment. These flow switch applications do not require precise accuracy.

Postaccident Monitoring (PAM) Orifices

A TVA letter to NRC (Ref. 48) indicated that the Regulatory Guide 1.97 PAM functions will not be assigned to specific instruments until 6 months before fuel load. However, typical orifices that could serve the PAM function were identified for purposes of this review. The orifices identified as used for primary control or PAM functions, and which might require "precise" accuracy, are listed in Table 14, Attachment D. Meriam was not identified as an orifice supplier for BLN. The majority of orifices used at BLN were supplied by the Daniel Measurement Co. (Daniel) (Ref. 49). Several other vendors were in evidence as listed in Table 13, Attachment D. Most of the safety-related orifices were provided by the Bailey Meter Co. as a subcontractor to Babcock and Wilcox Co. (B&W) (Ref. 50).

A review of selected hole sizing calculations from Daniel indicated that Daniel routinely uses a "precise" method that incorporates a viscosity correction factor. The Daniel correction factor ranges from 0 to 4 percent, thus providing additional agreement with the 2 to 3 percent corrections in the Bechtel calculations for SQN (Ref. 20). BLN orifice plate flow element CA IFE-003 generates a signal to the auxiliary feedwater pump/turbine flow control system. However, a review of the main steam and feedwater systems drawings, design criteria, design guides, and FSAR description shows that this flow element is used to limit feedwater pump/turbine maximum speed and not to modulate flow control.

A review of the Bailey orifice calculations was attempted (Ref. 51). It was not successful because the sizing calculations were never provided to TVA or B&W. Discussions with TVA, B&W, and Bailey indicated that the calculations are available for auditing as needed. A typical Bailey specification for the ND-IFE-902B orifice indicates parameters that imply that a "plant" sizing methodology was used. Bailey personnel indicated (Ref. 52) that they use the methodology in the 1971 ASME, "Report on Fluid Meters." This methodology does not differentiate between "plant" and "precise," and does not usually include a viscosity correction. While none of the orifices in Table 14 require the accuracy attributable to a "precise" calculation, the accuracy of these orifices will have to be established to comply with Design Standard DS-E18.1.10.

Loop Accuracy Verification

The Loop Accuracy Verification Program previously mentioned in the WBN and SQN reviews will be implemented at BLN in response to Policy Memorandum PM86-02 (EEB), (Ref. 53). Policy Memorandum PM86-02(EEB) "identifies all EEB-controlled electrical calculations necessary to fully document the design basis" for all TVA nuclear plants, including Bellefonte. The Instrument and Control Calculations, item 9, "Setpoint and Accuracy Calculations . . . important to safety . . ." are identified as "must be performed before fuel load or plant restart, for . . . the Bellefonte Nuclear Plants." No evidence of any existing calculations for the verification program was found. However, it was stated (Ref. 51) that the loop accuracy calculations will account for engineering design errors, and will relate the inaccuracies to the appropriate safety limits per Design Standard DS-E18.1.10. A search (Ref. 54) for selected system safety limits resulted in identifying only a few B&W assigned parameters in B&W Technical Document BWNP 20007 (Ref. 55).

The loop accuracy calculations constitute one part of the Electrical Engineering Calculations Program. Employee Concern Element 20501 resulted in Corrective Action Plan 20501-NPS-04. The verification of the corrective action will ensure that the electrical engineering calculations are completed before fuel load for Bellefonte.

Summary of BLN Evaluation

The evaluation team established that the employee concerns are not specifically valid for BLN because Meriam was not a BLN supplier. The major supplier of orifices, Daniel Industries, was confirmed as using the "precise" sizing methodology. However, the concern raised by the NSRS report for WBN -- that the acceptability of the orifice inaccuracies for PAM will depend upon a design evaluation -- is still valid for BLN as well.

A program exists under Policy Memorandum PM86-02 to complete a series of loop accuracy verification calculations for safety systems prior to startup. These calculations will include a verification that the orifice design inaccuracies due to the "plant" methodology are within the acceptable range when related to the appropriate safety limits per Design Standard DS-E18.1.10. These loop accuracy calculations, if satisfactorily completed, will address the orifice inaccuracy questions for safety-related orifices.

4.4 <u>Panel Drains - Element 229.2</u>

4.4.1 Overview

Concerns IN-85-143-003, IN-85-197-002, IN-85-514-002, IN-85-748-001, IN-85-952-001, and IN-85-983-001 were all raised for WBN and are concerned with instrument panel drains in the Reactor Building raceway. They are merely more detailed expressions of the broader SQN concern, XX-85-127-001, which states that "'hot' panel drains are routed into the floor drains instead of closed tanks." The specific "hot" (i.e., potentially radioactive) panel drains are not identified by the concerned individual (CI). All WBN concerns were therefore addressed in the context of the one generic SQN issue.

Since the concern presented a generic personnel exposure issue, it was also addressed for BLN and BFN. BFN is a boiling water reactor (BWR) with a radioactive steam cycle, while SQN, WBN, and BLN are pressurized water reactors with nonradioactive steam cycles. Therefore, while this issue was found not to require corrective actions at SQN, it presents a different and more difficult set of circumstances for a BWR like BFN.

4.4.2 Evaluation Approach

The concerns, taken together, suggest that potentially radioactive drainage inventory may be released to the environs because of the "open" nature of the drainage system. The presumed release path within the plant would arise from venting of gases or backflow of liquids through the open drain fixtures embedded in the concrete floor. The offsite release path postulated by interpretations of Concern IN-85-983-001 would be via a presumed conventional sewage/storm drainage path, as is the case with plumbing of this type in a commercial building designed to the Uniform Plumbing Code. While these concerns are accurately stated, to understand whether or not they require corrective action requires knowledge of the particular plant's drainage system design, specific identification of the potentially radioactive drainage sources, and a knowledge of how these "hot" sources are connected through the instrument and sampling panels to the drainage systems. The subject is treated for each plant separately below, with the SQN and WBN evaluations combined because of the similarity of the two plants. A related issue pertaining to the rerouting of instrument panel drain lines to open floor drains is reported in Subcategory Report 10700, "Instrument Tubing."

4.4.3 SQN and WBN Evaluations

The evaluation approach at all four plants was initially established by the SQN review. The following technique is therefore both specific to the SQN and WBN evaluations and applicable, except as noted, to those for BFN and BLN.

Identification of "Hot" SQN Sources

In the context of the concerns, the terms "hot panels," "contaminated instrument drains," and "hot systems" are taken to mean instrument and sampling panels that receive inventory from sources having a reasonable potential for carrying radioactive material. Generally, these include the primary loop (reactor coolant) and those auxiliary systems that handle reactor coolant.

Note 14 of SQN Drawing 47W600-24, R17 states that Systems 62, 63, 68, 74, 77, 81, and 87 "present radiation hazards and must have the panel drains routed to the closed drainage system." These systems are functionally identified as:

System 62	Chemical and Volume Control System	(CVCS)
System 63	Safety Injection System	(SIS)
System 68	Reactor Coolant System	(RCS)
System 74	Residual Heat Removal	(RHR)
System 77	Waste Disposal System	(WDS)
System 81	Primary Makeup Water System	(PWS)
System 87	Upper Head Injection	(UHI)

Identification of "Hot" WBN Sources

Note 6 of WBN Drawing 47W600-0-4, R29 states that Systems 62, 63, 68, 72, 74, 77, 78, and 81 "present a radiation hazard and must have the . . . panel drain lines routed to the closed drainage system." These systems are functionally identified as:

System 62	Chemical and Volume Control System	(CVCS)
System 63	Safety Injection System	(SIS)
System 68	Reactor Coolant System	(RCS)
System 72	Containment Spray System	(CSS)
System 74	Residual Heat Removal System	(RHR)
System 77	Waste Disposal System	(WDS)
System 78	Spent Fuel Pit Cooling System	(SFCS)
System 81	Primary Makeup Water System	(PWS)

Recognizing the potential for primary-to-secondary carryover in the steam generator, the sample lines from steam generator blowdown were also identified as hot for the purpose of the WBN and SQN evaluations.

SQN Nomenclature Inconsistencies

The evaluation was difficult because of SQN nomenclature inconsistencies between various review documents (e.g., the FSAR description and design drawings). These inconsistencies are outlined in some detail below because they established a peripheral finding.

FSAR Sections 9.3.3 and 11.2 and design drawings (Ref. 245) both describe two principal building drainage "systems." The unrestricted application of the term "system" initially led the evaluators to believe that there was an organized set of interacting drainage paths classified on the basis of contamination potential (tritiated or nontritiated), containment effectiveness (open or closed), and connection type or location (equipment or floor). This was not the case.

In an effort to provide some uniformity, the evaluators restricted the term "system" to describe the drainage paths and final repositories in each of the buildings. In the Reactor Building, there is only one drainage "system." In the Auxiliary Building the drainage system is divided into three "subsystems," each draining to a separate receiver. The terms "open and closed" were limited to describing the type of receiving connection at the drainage system inlet. All floor drains, by their very nature, are open, but equipment drains can be either open or closed. Design details exist for both.

The FSAR used the terms "tritiated and nontritiated" to describe overall design philosophy. While tritiated drains are, by definition, radioactive, it is not correct to say that nontritiated drains are free of any potential for radioactive inventory. In using the terms "tritiated" and "nontritiated," therefore, the FSAR does not describe two "systems" as such, in its effort to convey an overall design basis. Rather, it describes two general wastewater categories, along with several subcategories.

Nomenclature for individual items of equipment was found to be similarly inconsistent. For example, the tank designated "Tritiated Drain Collector Tank" on the flow diagrams (Ref. 64) is designated "Waste Holdup Tank" on the piping drawings (Ref. 64). These inconsistencies are clarified where possible in the following text, and where dual identities are found, both are referenced.

Such inconsistencies may have confused the CI and probably account for many of the concerns. It is also possible that the absence of SQN design criteria specifically addressing drainage systems denied the CI the knowledge necessary to put his concern to rest. The closest related design criteria were DC-V-8.1 and DC-V-8.2, both dated 02/23/71, which address radioactive wastes. These design criteria generally require the designer to follow reactor vendor (Westinghouse) drawings and were inactivated 10/26/76. Therefore, there now exists no single source document that can address this issue. (This design drawing subject is treated more fully in Subcategory 20600.)

WBN Nomenclature Inconsistencies

As was the case for SQN, WBN had its own set of inconsistencies between the various design and licensing documents. At WBN, however, the evaluation team augmented its document review with a physical walkdown at the plant. The WBN FSAR (Ref. 63) and the design drawings (Ref. 64) both describe two principal building drainage "systems." The unrestricted application of the term "system" in the WBN FSAR initially led the evaluators to believe that there was an organized set of interacting drainage paths classified on the basis of contamination potential (tritiated or nontritiated), containment effectiveness (open or closed), and connection type or location (equipment or floor). Further evaluation established that this was not the case.

Water System. As described, nonchromated nontritiated wastewater is conducted to the Floor Drain Collector Tank, monitored, treated if necessary, and recycled or released depending on plant operating needs.

It is clear from Section 9.3.2 of the FSAR description (Ref. 11) that the SQN drainage system design philosophy centered around controlling release and reprocessing wastewater. Personnel exposure was not mentioned. This is consistent with the safety evaluation of the process sampling system where the presence of potentially radioactive ". . . sample lines outside containment are not considered hazardous because of their limited flow and nonessential nature."

WBN FSAR Description

The FSAR description (Ref. 63) was reviewed to establish design intent in the same manner as outlined above for SQN. WBN FSAR Section 9.3.3, "Equipment and Floor Drainage System," and Section 11.2, "Liquid Waste Systems," separate wastewater on the basis of its tritium concentration just as previously described. The WBN FSAR reads so closely to the SQN FSAR that separate presentation here is unnecessary.

SQN Drawing Review

With the basic design intent established by the FSAR, the design drawings were reviewed to establish how the intent was carried into practice. The design drawings employ the terms "open and closed" and "floor and equipment." Drawings 47W851-1 and 47W852-1 through -4 (Ref. 245), "Flow Diagrams, Floor and Equipment Drains," show these major drainage systems, one in each Reactor Building and one in the Auxiliary Building, to be made up of three subsystems. The drainage system of each building functions as described below.

Reactor Building Drainage System. Drawings 47W476-2 through -8 (Ref. 245), "Containment Drains and Embedded Piping," show the drains and drain piping inside the containment liner in the Reactor Building. These drains and piping accept inventory from both the open and closed types of drain connections. The open drain connections are different variations of a traditional pipe and funnel arrangement, often a small drain tube extending down inside a larger diameter standpipe. These open drain connections, which also include flush mounted hubs embedded in the concrete floor (i.e., floor drains), would allow overflow of wastewater if the drain receiving lines or headers became plugged. Any entrained gases would be free to vent from these open drain connections as well.

The closed type of drain connections are continuous from the equipment drain connection point to the drain headers. Overflow of wastewater and venting of entrained gases would not occur in a closed type of drain connection.

To provide some uniformity, the evaluators restricted the term "system" to describe the drainage paths and final repositories in each of the buildings. In each WBN Reactor Building, there is only one drainage "system." The WBN Auxiliary Building drainage system is divided into four "subsystems," each draining to a separate receiver. The terms "open and closed" were limited to describing the type of receiving connection at the drainage system inlet. All floor drains, by their very nature, are open, but equipment drains can be either open or closed. Design details exist for both.

The WBN FSAR used the terms "tritiated and nontritiated" to describe overall design philosophy. While tritiated drains are, by definition, radioactive, it is not correct to say that nontritiated drains are free of any potential for radioactive inventory. In using the terms "tritiated" and "nontritiated," therefore, the WBN FSAR does not describe two "systems" as such. Rather, it is describing two general wastewater categories, along with several subcategories, in its effort to convey an overall design basis.

As was the case with SQN, such inconsistencies may have confused the CI and probably account for many of the WBN concerns. It is also possible that the absence of WBN design criteria specifically addressing drainage systems denied the CI the knowledge necessary to put his concern to rest.

SQN FSAR Description

Because no SQN design basis documents were available that would establish an overall drainage system design intent, the evaluators reviewed the SQN FSAR description.

FSAR Section 9.3.3, "Equipment and Floor Drainage System," and Section 11.2, "Liquid Waste Systems," separate wastewater on the basis of its tritium concentration. Since tritium is an activation product generated in the reactor coolant, the handling of any tritiated wastewater must be consistent with the handling of any primary loop inventory. Tritiated wastewater is handled separately from nontritiated wastewater. "Nontritiated" wastewater is defined as wastewater with a tritium concentration of up to 10 percent of the tritium concentration of the primary (reactor) coolant. Above this concentration, the wastewater is considered tritiated.

Tritiated wastewater is classified on the basis of dissolved oxygen content as "aerated" or "deaerated." Deaerated tritiated wastewater is collected in the Reactor Coolant Drain Tank or the CVCS Holdup Tank and recycled into the primary loop. Aerated tritiated wastewater is conducted to the Tritiated Drain Collector Tank, where it is treated prior to reuse or release from the plant.

Nontritiated wastewater is classified in the FSAR as "chromated" or "nonchromated." Chromated nontritiated wastewater is collected in the Component Cooling System Surge Tank and recycled in the Component Cooling

The Reactor Building drain headers terminate in the Reactor Building Floor and Equipment Drain Sump. Therefore, both open equipment and floor drains and closed equipment drains are part of a common drainage system. The Reactor Building Drain System headers discharge to either the Reactor Building sump or to an auxiliary sump, which is pumped back to the Reactor Building sump. From here, the inventory is pumped to the Tritiated Drain Collector Tank (Waste Holdup Tank) or to the Floor Drain Collector Tank, where it is sampled to establish treatment requirements prior to release or recycling. On the basis of this review, unmonitored or untreated release off the site is unlikely.

Auxiliary Building Drainage System. Three subsystems handle drainage within the Auxiliary Building. Each is described separately below.

- The "lower level" Auxiliary Building drainage subsystem has separate parallel headers from both open and closed drain connections that discharge wastewater from level 653 of the building to the Auxiliary Building Floor and Equipment Drain Sump. This subsystem handles potentially radioactive inventory (e.g., RHR System leakage).

- The (tritiated) "upper level" Auxiliary Building drainage subsystem has separate parallel headers from open and closed drain connections that discharge wastewater from levels 734, 714, 690, and 669 of the building to the Tritiated Drain Collector Tank. Separate headers are connected to the Tritiated Drain Collector Tank (Waste Holdup Tank) through a water seal arrangement which prevents venting of entrained gases back through the floor drains. Elevation differences prevent backflow of liquids from the closed to the open headers.

- The (nontritiated) "upper level" Auxiliary Building drain subsystem uses open-type connections to headers that discharge to the Floor Drain Collector Tank.

Drawing 47W476-1 (Ref. 245), "Annulus Floor Drains and Embedded Piping," shows the drains and drain piping in the annulus between the containment liner and the outer wall of the Reactor Building. This piping drains into the Auxiliary Building Passive Sump and from there to the Auxiliary Building Floor and Equipment Drain Sump.

WBN Drawing Review

WBN Drawings 47W851-1 and 47W852-1 through -4, "Flow Diagrams, Floor and Equipment Drains" (Ref. 64), parallel those of SQN and show three major drainage systems, one in each Reactor Building and one in the Auxiliary Building which is made up of four subsystems. The drainage system of each building functions as described below.

Reactor Building Drainage System. WBN Drawings 47W476-2 through -8, "Containment Drains and Embedded Piping" (Ref. 64), show the drains and drain piping inside the containment liner in the Reactor Building to be the same as described for SQN above.

Auxiliary Building Drainage System. The WBN Auxiliary Building Drainage piping differs slightly from that of SQN. WBN Drawings 47W478-1, "Embedded Piping, Base Slab," and 47W479-1 through -11, "Drains and Embedded Piping" (Ref. 64), show that the four subsystems are separated on the basis of level (upper and lower) and tritium content and handle drainage within the WBN Auxiliary Building. Each WBN subsystem is described separately below.

- The (tritiated) "lower level" Auxiliary Building drainage subsystem has separate parallel headers from primarily closed drain connections that discharge wastewater from levels 692 and 676 of the building to the Auxiliary Building tritiated drain sump. This sump is pumped periodically to the tritiated drain collector tank.

- The (nontritiated) "lower level" Auxiliary Building drainage subsystem has headers from primarily open drain connections that discharge wastewater from level 676 of the building to the Auxiliary Building floor and equipment drain sump. This sump is pumped periodically to the floor drain collector tank.

- The (tritiated) "upper level" Auxiliary Building drainage subsystem has separate parallel headers from primarily closed drain connections that discharge wastewater from levels 757, 737, 713, and 692 of the building to the tritiated drain collector tank. Separate headers are connected to the tritiated drain collector tank through a water seal arrangement as is the case at SQN.

- The (nontritiated) "upper level" Auxiliary Building drain subsystem uses open-type connections to headers that discharge to the floor drain collector tank just like SQN.

Normally, liquid waste in the tritiated drain collector tank is recycled, and liquid waste in the floor drain collector tank is released. No liquid waste is released from either drain collector tank unless it is first monitored and treated.

WBN Drawing 47W476-1, "Annulus Floor Drains and Embedded Piping" (Ref. 64), shows that the drains and drain piping in the annulus between the containment liner and the outer wall of the Reactor Building are the same as at SQN.

In the Auxiliary Building, Drawing 47W478-1, "Embedded Piping Base Slab," and Drawings 47W479-1 through -11, "Drains and Embedded Piping," show 63 open and 23 closed drain headers in the building. At the lowest level (El. 676), 17 open headers and four closed headers terminate in the Auxiliary Building sump below water, thereby effecting water seal isolation. At the higher levels, 30 of the open drain headers connect to manifolds that terminate in the Floor Drain Collector Tank; the remaining 16 open drain headers and all 19 of the closed drain headers connect to manifolds that terminate in the Tritiated Drain Collector Tank (which is called the Waste Holdup Tank on these drawings).

SQN Drawing Review Walkdown Results

SQN Reactor Building. The SQN Reactor Building panel drains are discussed in Nuclear Safety Review Staff (NSRS) Investigation Report I-85-921-SQN (Ref. 59). This report was prepared in response to Concern XX-85-127-002 (and is more fully discussed in SQN Element Report 232.2, "Carbon Steel versus Stainless Steel Drainage Piping"). NSRS Report I-85-921-SQN states that, as a result of the SQN unit 2 Reactor Building raceway walkdown where all panel instruments were physically examined by NSRS and a plant instrument engineer:

- "None of the panels has external drain tubes, pipes, or hoses attached."
- "When it was necessary to drain a section of [instrument] tubing within a panel, it was drained into a container for disposal later."
- ". . . there was no direct draining . . . onto the floor."
- "The possibility of draining onto the floor does exist. However, this was not done as no informed technician would drain contaminated fluid on the floor and risk contaminating himself or others while calibrating or performing maintenance on instruments."

The report concludes: "No drains were found connected to the panels." It should be noted that the NSRS report restricts itself to the unit 2 Reactor Building raceway drains from instrument panels. The 47W600-series drawings (Ref. 245), "Instruments and Controls," show that ten hot instrument panels in the Reactor Building have drain connections. However, the drawings do not clearly indicate how these drains are connected to the Reactor Building drainage system.

A physical walkdown by Bechtel ECTG personnel (Refs. 60, 61, and 62) confirmed the above statement for SQN unit 2, but found one instrument panel (1-L-361) connected to an open drain header in the SQN unit 1 Reactor Building Raceway. In addition, five instrument panels (1-L-187, 1-L-191, 1-L-358, 1-L-359, and 1-L-360) inside the crane wall in Reactor Building 1 and three instrument panels (2-L-191, 2-L-358, and 2-L-360) inside the crane wall in Reactor Building 2 were found to be connected to open drain headers. For reasons explained below under Personnel Exposure and Release Control, this should not be cause for concern. Data from the walkdown are presented in Tables 15 and 16, Attachment D.

<u>SQN Auxiliary Building</u>. Data from the walkdown show that 37 of 72 hot Auxiliary Building instrument panels have drain connections. Of these, 33 are connected to a closed drain header. Instrument Panels 1-L-27 and 2-L-27 are connected to drain headers identified as "open." However, these headers have no floor drain connections and terminate in the Waste Holdup Tank (Tritiated Drain Collector Tank). Therefore, they have closed header characteristics. Instrument Panels 0-L-14 and 1-L-15 are connected to open drain headers at a point below the floor drain openings. For reasons which are explained later under Personnel Exposure and Release Control, this should not be a cause for concern. Data that were not available from the drawings were obtained from physical walkdowns by Bechtel ECTG personnel (Refs. 60, 61, and 62).

Tables 15 and 16, Attachment D, also show that 11 of the 37 sampling panel drains in the Auxiliary Building are connected to closed drain headers. Five hot sampling panel drains are connected to headers identified as "open." However, these headers have no floor drain connections and also terminate in the Waste Holdup Tank (Tritiated Drain Collector Tank). Therefore, they have closed header characteristics as well. The drains from sampling panels 1B, 2B, A8, 1-B19, and 2-B19 are connected to an open drain header at a point below the floor drain openings. Panels 1B and 2B draw samples from the Boric Acid Blender, the Containment Floor and Equipment Drain Sump, the Primary Loop Pressurizer Accumulators, and Steam Generator Blowdown. Panel A8 draws samples from the CVCS Volume Control Tanks, the Spent Resin Storage Tank, the RCS Pressurizer Relief Tanks, the WDS Gas Decay Tank, and the CVCS Holdup Tanks. Panels 1-B19 and 2-B19 draw samples through Panels 1-A19 and 2-A19, respectively, from Hot Leg Loops 1 and 3 and Residual Heat Exchangers A and B and through Panels 1-C19 and 2-C19, respectively, from the Containment Air.

WBN Drawing Review/Walkdown Results

<u>WBN Reactor Building</u>. The evaluation team identified 140 hot instrument panels in the Reactor Buildings. These data are summarized as follows:

- o 17 panels in unit 1 (and probably 3 more that were inaccessible) and 20 panels in unit 2 have drains piped into floor drains in the raceway at elevation 702.8.
- o 32 panels in unit 1 and 35 panels in unit 2 have drains with closed connections to the building drainage system.
- o 5 panels in unit 1 and 6 panels in unit 2 do not require drain connections.

- 11 panels in unit 1 and 2 panels in unit 2 could not be located where shown on the drawings. (Note: No CATD was written here because reconciliation of As Built drawings as a separate subject is addressed in Subcategory Report 206.00)

- 5 panels in unit 2 are under construction and their drains were not connected to the building drainage system.

- 2 panels in each unit had valved drain connections that are not connected to the building drainage system.

In the Auxiliary Building, where access control is less restrictive but where health physics controls are still enforced, the same argument as in the Reactor Building against backflow of drains and venting of gases applies. Here, however, where the separated drains have common points of isolation, water seals are designed into the piping to prevent the spread of airborne radioactivity into the open system. Some exceptions to this general design practice have been noted and are being handled under a separate program (Refs. 57 and 58). The elevation differences, drain piping size, and water seal isolation all reduce the exposure risk to insignificance.

<u>WBN Auxiliary Building</u>. Data were also collected for 177 hot instrument panels and 14 hot sample sinks in the Auxiliary Building. These data are summarized as follows:

- 84 instrument panels and 8 sample sinks have closed connections to closed drain headers that terminate in the tritiated drain collector tank.

- 70 panels do not require drain connections.

- 9 panels could not be located where shown on the drawings. (Note: No CATD was written here because reconciliation of As Built drawings as a separate subject is addressed in Subcategory Report 206.00)

- 7 panels have valved drain connections but are not connected to the building drainage system.

- 3 panels are each connected to an open standpipe that is "sealed" with a soft plug; 1 of the panels is connected to the tritiated drain collector tank and 2 to the (nontritiated) floor drain collector tank.

- 3 panels were still under construction and, as yet, had no drain connection.

- 2 panels and 4 sample sinks have closed connections to open drain headers that terminate at the (nontritiated) floor drain collector tank.

- 1 sample sink is connected through an open funnel drain to an open drain header that terminates at the floor drain collector tank.

- 1 sample sink is connected through a closed connection to an open drain header that terminates in the nontritiated Auxiliary Building floor and equipment drain sump.

SQN Panel Drains

While the CIs suggest a more general concern about the control of potentially radioactive liquids, a more specific concern related to instrumentation and sample panel drains was also raised. This concern necessitated a review of the design drawings specific to these pieces of equipment.

Drawings 47W600-0-1 through -4, "Instruments and Controls" (Ref. 245), list the instrument panels. The remaining SQN 47W600 drawings, 289 in all, include piping diagrams and details showing the process inlet lines (usually a 1/2-inch stainless steel pipe) and, if appropriate, the outlet drain lines. The review data for SQN hot instrument panels are tabulated in Table 15, Attachment D. Drawings 47W625-1 through -21, "Radiation Sampling System" (Ref. 245), include schematic piping diagrams of the individual sampling stations. These drawings show the source of each sample, the line to the appropriate sampling panel (usually 3/8-inch stainless steel tubing), and the drain connection from each panel. Data for sampling panels are tabulated in Table 16, Attachment D. To be consistent with the foregoing, this review is also separated on a building-by-building basis.

Most hot instrument panel and sample sink drains connected to the gravity drainage piping use a closed type connection where the piping is continuous from the instrument or sink to the sump. This type of connection presents no opportunity for overflow of wastewater or venting of entrained gases. A few hot instrument panel and sample sink drains use open standpipe or open funnel drain connections that do present an opportunity for wastewater overflow or entrained-gas venting.

WBN Panel Drains

WBN Drawings 47W600-0-1 through -49, "Instruments and Controls" (Ref. 64), list the instrument panels. The remaining WBN 47W600-series drawings, 322 in all, show the location of each panel in the plant, the identification and physical arrangement of the instruments on the panel, the schematic piping from the process lines and equipment to the panel, and the schematic piping of the instruments on the panel. In some cases, the drainage piping is shown schematically; in others, the piping is left to the discretion of the field. Frequently, the drainage piping terminates on the panel and is not shown connected to the plant drainage system. Therefore, it was considered necessary to walk down the drain connection of each panel (Ref. 65).

A total of 317 hot instrument panels are shown on the drawings. The inspection data for these panels are tabulated in Table 17, Attachment D. WBN Drawings 47W625-1 through -21, "Radiation Sampling System" (Ref. 64), show the location and physical arrangement of the sinks, and the schematic piping from the sample point to the sink and from the sink to the plant drainage system. The drawings show there are 14 hot sample sinks. Some sinks are identified by an instrument panel number, others are not.

Seven hot instrument panels are not connected to the building drainage system. The drain connection of each instrument on these panels is valved. Frequently the lines from the drain valves are manifolded, and the ends of the manifolds are valved. When it is necessary to drain these panels, the drainage must be collected in a portable container. As was observed in Nuclear Safety Review Staff (NSRS) Investigation Report I-85-921-SQN (Ref. 59), with this arrangement "the possibility of draining onto the floor does exist. However, this [is] not done as no informed technician would drain contaminated fluid on the floor and risk contaminating himself or others while calibrating or performing maintenance on instruments."

Floor Drains

Floor drains contain no backwater (check) valves and are not trapped. Open gravity piping connects floor drains to the building drainage system. Therefore, where hot instrument panel and sample sink drains are connected to floor drains or to open gravity piping, there is an opportunity for wastewater overflow or entrained-gas venting even if the instrument panel or sample sink connection to the gravity piping is closed.

Personnel Exposure

Because the Reactor Building drainage systems have closed equipment drain connections to open drain headers, the potential for backflow and venting exists. Because of the small volumes handled, the low contamination level of the effluent, the large size of the receiving headers, and the elevation differences, backflow of potentially radioactive drainage into the floor drains is unlikely. Similarly, because of the small volumes, the tendency for dissolved gases to remain in the liquid, and the relatively low inventory of dissolved gases that would be radioactive, the venting of such gases through the open floor drains presents an insignificant exposure. Operating temperatures are not sufficient to cause boiling. It must be recognized that the Reactor Building is not normally occupied during operation, when the exposure potential is highest. Any entry to the Reactor Building is made under close administrative control with substantial health physics procedures in place. The exposure potential due to drains is insignificant compared with the other hazards present. The total exposure potential within the Reactor Building is subject to continuing As Low As Reasonably Achieveable (ALARA) and health physics review. No changes have been necessary as a result of these reviews.

Release Control

From a detailed review of the drawings, it is evident that the drainage in each building terminates in either the Tritiated Drain Collector Tank (Waste Holdup Tank) or the Floor Drain Collector Tank in the Auxiliary Building. From these tanks, the wastewater is pumped to the Waste Disposal System. Discharge of any wastewater after treatment is subject to monitoring and is under administrative control. By design, no drainage is released to the environs without proper monitoring and treatment.

Summary of SQN and WBN Evaluations

From this review, it was determined that no Auxiliary Building panels are connected to open floor drains. These panel drains function in a way that prevents the release of radioactivity to the environment. All of the panel drains ultimately terminate in closed collector tanks where the drainage is monitored and processed prior to reuse or release.

The evaluation team found that Concern XX-85-127-001 is correct as stated. There are cases where potentially radioactive panel drains are routed to headers that connect to open floor drains. However, no prohibition exists against this practice within certain design considerations. These design considerations were employed to the extent that:

- Potentially radioactive inventory will not be released without proper monitoring and treatment
- Potential exposure of operating personnel is consistent with ALARA guidelines and accepted health physics practices

On these bases, the concern, while correctly stated, does not present a factual issue requiring corrective action.

4.4.4 BLN Evaluation

Identification of Hot Sources

The hot sources for BLN were identified using the same criteria as outlined for SQN and WBN above. The drainage system at BLN was examined by documentation review and physical walkdown. BLN is a PWR of a different make from WBN or SQN, so its lists of sources differ slightly. Note 3 of BLN Drawing 5AW0911-IO-21, "Instruments and Controls, Typical Details and Installation" (Ref. 68), identifies the following systems as tritiated: CN, NB, NC, ND, NL, NM, NS, NV, WL, and YM. These systems are functionally identified as:

CN	Condensate demineralizer system
NB	Chemical addition and boron recovery system
NC	Reactor coolant system
ND	Decay heat removal system or RHR shutdown cooling system/safety injection system
NL	Core flooding system/safety injection tank subsystem
NM	Spent fuel cooling and cleaning system/pool cooling and purification system
NS	Reactor Building spray system
NV	Makeup and purification system (chemical and volume control system)
WL	Liquid radwaste disposal system
YM	Makeup demineralizer system

In recognition of the potential for primary-to-secondary carryover in the steam generator, the sample lines from steam generator blowdown were also identified as hot for the purpose of this evaluation.

BLN FSAR Description

The design bases for the BLN drainage system are stated in FSAR Section 9.3.3, "Equipment and Floor Drainage System":

> "The equipment and floor drainage system is designed primarily to collect equipment and floor drainage in such a manner that the segregation and safe disposal of radioactive and nonradioactive effluents will be assured during the various modes of operation of the plant. This is accomplished by providing:
>
> - Separate drain collection headers for tritiated, nontritiated, and nonradioactive drains.
> - Separate open drain headers from each zone in the Auxiliary Building to provide zonal separation. . . .
> - Piping to the Liquid Waste Disposal System for all Auxiliary and Reactor Building equipment and floor drainage. . . .
>
> The tritiated drains normally carry water with a tritium content of 10 percent or more of the tritium content of the reactor coolant. . . .
>
> Nontritiated drains carry water with a tritium content of less than 10 percent of the tritium content of the reactor coolant. . . ."

Because tritium is an activation product generated in the reactor coolant, the handling of any tritiated wastewater must be consistent with the handling of any primary loop inventory. Tritiated wastewater and nontritiated wastewater are handled separately.

BLN Drawing Review

With the basic design intent established by the FSAR, the design drawings were reviewed to establish how the intent was put into practice. BLN Drawing 3GW0858-00-02, "Flow Diagram, Station Drainage" (Ref. 69), describes the drainage system in the Reactor and Auxiliary Buildings, which functions as described below.

> "All drainage in the Reactor and Auxiliary Buildings is considered potentially radioactive. The system [is] designed so that no means exist for inadvertent transfer of drainage from these buildings to non-contaminated areas."

<u>Reactor Buildings</u>. BLN Drawings 3RW0463-00-01 through -07, "Drains and Embedded Piping" (Ref. 70), show the drains and drain piping inside the Reactor Building of unit 1. No drawings are provided for unit 2, which is opposite hand. These drains and piping accept inventory from both the open and closed types of drain connections. The open drain connections consist of small drain pipes extending down inside flush-mounted hubs embedded in the concrete floor (i.e., floor drains). These open drain connections would allow overflow of wastewater if the drain receiving lines or headers became plugged. Any entrained gases would be free to vent from these open drain connections as well.

The closed type of drain connections are continuous from the equipment drain connection point to the drain headers. Overflow of wastewater and venting of entrained gases would not occur in a closed type of drain connection.

Both open equipment and floor drains and closed equipment drains in the Reactor Building drain to the Reactor Building normal sump tank. From there, drainage is "normally transferred to the nontritiated waste holdup tank by the Reactor Building sump pumps. However, connections are provided to route the contents to the tritiated waste holdup tank if the tritium concentration of the drainage becomes excessive" (Ref. 71). The waste holdup tanks and sump pumps are located in the Auxiliary Building.

<u>Auxiliary Building</u>. BLN Drawings 3AW0462-00-01 through -39, "Drains and Embedded Piping" (Ref. 72), show the four piping subsystems that handle drainage within the Auxiliary Building. Each subsystem is described separately below.

- The (tritiated) "lower level" Auxiliary Building drainage subsystem has separate parallel headers from primarily closed drain connections that discharge wastewater from level 590 of the building to the Auxiliary Building tritiated sump tank. This tank is pumped periodically to the tritiated radwaste processing equipment.

- The (nontritiated) "lower level" Auxiliary Building drainage subsystem has separate parallel headers from primarily open drain connections that discharge wastewater from level 590 of the building to the Auxiliary Building nontritiated sump tank. This tank is pumped periodically to the nontritiated radwaste processing equipment.

- The (tritiated) "upper level" Auxiliary Building drainage subsystem has separate parallel headers from primarily closed drain connections that discharge wastewater from levels 686, 669, 649, and 610 of the building to the tritiated waste holdup tank. This tank drains to the tritiated radwaste processing equipment.

- The (nontritiated) "upper level" Auxiliary Building drainage subsystem uses open-type connections to headers that discharge to the nontritiated waste holdup tank. This tank drains to the nontritiated radwaste processing equipment.

The separate headers are connected to the Auxiliary Building sump tanks and waste holdup tanks through a water seal arrangement that prevents venting of entrained gases back through the drain piping.

No liquid is released from the radwaste processing equipment unless it has been monitored and treated.

BLN Drawing Review/Walkdown Results

Reactor Buildings. Data for 55 hot instrument panels in Reactor Building unit 1 were compiled and are presented in Table 21, Attachment D. The drawings indicate unit 2 will be opposite hand from unit 1. Construction of Reactor Building unit 1 is less advanced than that of the Auxiliary Building. No work has been done on Reactor Building unit 2 for approximately 2-1/2 years. No instruments have been installed as yet. The data of Table 21 for unit 1 are summarized below:

- 16 panels have closed drain connections
- 9 panels do not require drain connections
- 19 panels have drains not yet connected
- 11 panels could not be located (perhaps not yet installed)

Table 22, Attachment D, includes data for six hot sample sinks:

- o 3 sinks have closed drain connections
- o 2 sinks have drains not yet connected
- o 1 sink does not require a drain

Table 23, Attachment D, includes data for 34 grab sample stations:

- o 1 station drains to a floor drain
- o 2 stations have closed drain connections
- o 6 stations do not require drains
- o 6 stations do not have drains
- o 3 stations have drains not yet connected
- o 16 stations could not be located (perhaps not yet installed)

<u>Auxiliary Building</u>. Data for 120 BLN hot instrument panels were collected and analyzed. These data are presented in Table 20, Attachment D. Because BLN is still under construction, not all panels were installed; in some cases, drain connections were not complete. These data are summarized below:

- o 9 panels have drains piped into floor drains
- o 1 panel has a drain piped into a leak detector
- o 59 panels have closed drain connections
- o 31 panels do not require drains
- o 9 panels could not be located (perhaps not yet installed)
- o 6 panels have drains not yet connected
- o 5 panels were not accessible

Panel and Sink Drains

BLN 5AW-925-, 5AW-926-, 5AW-927-, and 5RW-925-series drawings, "Instruments and Controls, Local Panels" (Ref. 73), show the location of each instrument panel in the Auxiliary and Reactor Buildings, the identification and physical arrangement of the instruments on the panel, the schematic piping from the process lines and equipment to the panel, and the schematic piping of the instruments on the panel. In some cases, the drainage piping is shown schematically; in others, the piping is left to the discretion of the field. Frequently, the drainage piping is shown terminating on the panel and the connection to the plant drainage system is not shown. Therefore, it was considered necessary to walk down the plant and inspect the drain connection of each panel (Refs. 74 through 78). A total of 120 hot instrument panels are shown in the drawings of the Auxiliary Building and 55 in the Reactor Building of unit 1. Unit 2 is opposite hand. Inspection data for these panels can be found in Tables 20 and 21, Attachment D.

BLN Drawings 5GW0941-YQ-24 and -26, "Instruments and Control" (Refs. 79 and 80), show the hot sample sinks, and BLN Drawing 5GW0941-YQ-21, "Instruments and Controls" (Ref. 81), lists the grab sample stations in the Auxiliary Building. These drawings show the location of the hot sample sinks and stations, the schematic piping from the sample point, and, in some cases, the schematic piping to the plant drainage system. The drain connections for the hot sample sinks and grab sample stations were also inspected by walkdown (Ref. 82). The inspection data are included in Tables 22 and 23, Attachment D.

Personnel Exposure

Using the rationale previously described for SQN and WBN, the evaluation team concluded that there was an insignificant potential for personnel exposure due to open floor drainage. Even though BLN is not operational, the total exposure potential within the buildings will be subject to the same continuing health physics review as found at the other TVA stations. BLN may also be in a superior position to integrate lessons learned and experience gained at the other TVA units.

Release Control

From a detailed review of the drawings, it is evident that the drainage in the Reactor Buildings and the Auxiliary Building terminates in either the tritiated waste holdup tank or the nontritiated waste holdup tank. From these tanks the wastewater flows to the liquid radwaste disposal system for treatment. Discharge of any wastewater after treatment is subject to monitoring and is under administrative control. By design, no drainage is released to the environs without proper monitoring and treatment.

Most hot instrument panel and sample sink drains connected to the gravity drainage piping use a closed-type connection where the piping is continuous from the instrument or sink to the sump. This type of connection presents no opportunity for overflow of wastewater or venting of entrained gases.

A few hot instrument panel and sample sink drains are connected to a floor drain and one discharges to a leak detector. The floor drains and leak detector contain no backwater (check) valves and are not trapped, so there is an opportunity for wastewater overflow or entrained-gas venting. However, because of the small volumes handled, the low contamination level of the effluent, the large size of the receiving headers, and the elevation differences, backflow of potentially radioactive drainage into the floor drains is unlikely. Similarly, because of the small volumes, the tendency for dissolved gases to remain in the liquid, and the relatively low inventory of dissolved gases that would be radioactive, the venting of such gases through the open floor drains or leak detector presents an insignificant exposure issue.

Summary of BLN Evaluation

The evaluation team found that concern XX-85-127-001 is correct as stated for BLN. There are cases where potentially radioactive panel drains are routed to open floor drains. However, no prohibition exists against this practice within certain design considerations. These design considerations were employed at BLN to the extent that:

- o Potentially radioactive inventory will not be released without proper monitoring and treatment
- o Potential exposure of operating personnel is consistent with accepted health physics practices

On these bases, the concern, while correctly stated, does not present a factual BLN issue requiring corrective action.

4.4.5 BFN Evaluation

BFN, being a BWR with radioactive constituents in its steam condensate feedwater cycles, presents a higher potential exposure to personnel and a higher risk of uncontrolled release. The BFN drainage system was examined in a manner similar to that at SQN and WBN. Nomenclature inconsistencies were not a problem at this plant. However, the fact that BFN is a BWR requires some differentiation from the foregoing and further explanation.

Identification of "Hot" Sources

The same definitions used at SQN, WBN, and BLN to identify "hot panels" were used at BFN. For a BWR, this includes the main steam, condensate, and reactor feedwater systems and those auxiliary systems that handle fluids from these three systems. For the purpose of this evaluation, panels that include instruments or sample lines connected to any of the following systems were considered hot:

System Number	System Name
1	Main steam
2	Condensate and demineralized water
3	Reactor feedwater
4	Main steam crossties
5	Extraction steam
6	Heater drains and vents
37	Gland seal water
65	Standby gas treatment
66	Offgas
68	Reactor water recirculation
69	Reactor water cleanup
71	Reactor core isolation cooling
73	High-pressure coolant injection
74	Residual heat removal
75	Core spray
77	Radwaste
78	Fuel pool cooling and demineralizing
85	Control rod drive

BFN FSAR Description

No BFN design basis documents were available that establish an overall drainage system design intent. Therefore, the evaluators used the BFN FSAR description as a statement of design intent. This was augmented by a physical walkdown of the facility (Refs. 66 and 67).

The BFN FSAR, Section 10.16, "Equipment and Floor Drainage Systems," states:

> "The objective of the drainage systems is to collect and remove from the plant all liquid wastes from their points of origin to the [Tennessee] river directly, or if necessary to the radioactive waste [(radwaste)] building . . . , where they are treated and returned for reuse or discharged to the river . . . The drainage systems [were] designed to prevent the inadvertent release of significant quantities of liquid radioactive material from the . . . plant so that resulting radiation exposures are within the guideline values of 10CFR20 . . .

The plant drainage is handled through two completely separated drainage systems of the following categories:

a. Radioactive drainage

b. Nonradioactive drainage

Radioactive drainage consists of both equipment and floor drainage. Equipment drainage consists of waste leakage from equipment such as rotating shaft glands, miscellaneous line drains, and equipment drains for maintenance. With the exception of turbine building equipment drains, these [radioactive equipment drainage system] drains are collected in closed piping systems which terminate in closed and shielded sumps located were necessary to accommodate a gravity drainage system. In the turbine building, equipment drains from equipment that might contribute to airborne contamination are connected into closed headers (no funnels) and routed to equipment drain sumps. Equipment drains that are not considered to have this potential for airborne contamination are collected into open headers and routed separately to equipment drainage sumps. From these sumps the waste is pumped to the radwaste building where it enters the equipment drain collection tank to be held for treatment.

The radioactive floor drainage system drains areas which may contain radioactive materials. These are collected and piped to shielded sumps in a manner similar to equipment drains. . . Each separate drain header is terminated below minimum water level in the sump to effectively seal it from other drains. From these sumps waste liquid is pumped to radwaste where it enters the floor drain collector tank to be held for treatment.

The nonradioactive floor drains . . . are further divided into two collection systems:

a. Nonradioactive, noncontaminated drains

b. Nonradioactive drains of possible contamination

The nonradioactive, noncontaminated drains are collected in drain sumps located conveniently throughout the plant where level controlled sump pumps pump this drainage into the condenser circulating water discharge tunnels.

Drains of possible nonradioactive contamination such as floor drains installed below oil-filled transformers or lubricating oil tanks, where accidental oil spills could take place, are collected in a separate drainage system and sump. A very small amount of potentially radioactive drainage will be directed to this sump. However, removal from the sump is done on a noncontinuous basis, with treatment for oil removal, and after the determination that the discharge from the plant is always within the limits specified in 10CFR20.

BFN Drawing Review

With the basic design intent established by the BFN FSAR, the design drawings were reviewed to establish how the intent was carried into practice. The drainage design drawings (Ref. 83) show a number of drainage systems for both radioactive and nonradioactive drainage. Each drainage system consists of a sump, gravity piping (usually embedded in the concrete floors of the plant) from drainage connections to the sump, and pumps and pressure piping to remove drainage from the sump.

While the design drawings do not systematically identify the various drainage systems, the drawings do identify each sump. Sumps for clean radwaste are designated "equipment drain sumps"; for dirty radwaste, "floor drain sumps"; and for noncontaminated nonradioactive drainage, "station sumps." The sump for oily nonradioactive drainage is designated "emergency oil drain sump."

The following is a list of BFN sumps that receive drainage from hot panels:

Reactor Building equipment drain sump 1 (unit 1)
Reactor Building equipment drain sump 2 (unit 2)
Reactor Building equipment drain sump 3 (unit 3)
Reactor Building floor drain sump 1A (unit 1)
Reactor Building floor drain sump 1B (unit 1)
Reactor Building floor drain sump 2A (unit 2)
Reactor Building floor drain sump 2B (unit 2)
Reactor Building floor drain sump 3A (unit 3)
Reactor Building floor drain sump 3B (unit 3)
Turbine Building equipment drain sump 1A (unit 1)
Turbine Building equipment drain sump 2A (unit 2)
Turbine Building equipment drain sump 3A (unit 3)
Condensate pump pit equipment drain sump 1B (unit 1)
Condensate pump pit equipment drain sump 2B (unit 2)
Condensate pump pit equipment drain sump 3B (unit 3)
Turbine Building floor drain sump 1A (unit 1)
Turbine Building floor drain sump 2A (unit 2)
Turbine Building floor drain sump 3A (unit 3)
Condensate pump pit floor drain sump 1B (unit 1)
Condensate pump pit floor drain sump 2B (unit 2)
Condensate pump pit floor drain sump 3B (unit 3)
Backwash receiver pit floor drain sump A (units 1 and 2)
Backwash receiver pit floor drain sump B (unit 3)
Station sump, unit 1 (unit 1)
Station sump, unit 2 (unit 2)
Station sump, unit 3 (unit 3)

Radwaste Building equipment drain sump (units 1 through 3)
Radwaste Building floor drain sump (units 1 through 3)
Radwaste Evaporator Building floor drain sump (units 1 through 3)

Condensate pump pit sumps, backwash receiver pit sumps, and station sumps are all located in the Turbine Building.

The drainage from each equipment drain sump is pumped to the waste collector tank, which is part of the radwaste system and is located in the Radwaste Building. The contents of this tank are treated and then recycled (normally) or released as appropriate.

The drainage from each floor drain sump is pumped to the floor drain collector tank, which is part of the radwaste system and is also located in the Radwaste Building. The contents of this tank are treated and then recycled or released as appropriate.

Normally, the drainage from each station sump is pumped to the condenser circulating water system and discharged with the condenser cooling water to Wheeler Lake. Since Wheeler Lake is the portion of the Tennessee River impounded by Wheeler Dam, a discharge to this lake is consistent with a discharge "to the river" stipulated in the FSAR. Alternatively, this drainage may be pumped to the yard drainage system. Moreover, provision is made so that, if appropriate, the drainage in the station sump may be pumped to the floor drain collector tank of the radwaste system for treatment before release.

The following BFN sumps also receive drainage from hot panel drains.

- o Standby Gas Treatment Building sump whose drainage is pumped to the waste collector tank in the Radwaste Building
- o Offgas Treatment Building sump whose drainage is pumped to the stack sump
- o Stack sump whose drainage flows by gravity to the offgas condensate sump in the Radwaste Building
- o Offgas condensate sump whose drainage is pumped to the waste collector tank

BFN Drawing Review/Walkdown Results

The 47W475-, 47W476-, and 47W479-series drawings ("Embedded Piping, Stage I") indicate that, in the Reactor Building sumps and the (Turbine Building) station sumps, the gravity piping from the drain connections terminates below the minimum water level in the sump, thereby effecting a seal and preventing cross-venting of gases between the gravity drain piping systems. Gases could be vented at the sump, but not back through the piping system. This condition was confirmed by additional field review (Refs. 66 and 67).

Instrument Panels

Instrument panels are described by the BFN 47W600-series drawings, "Instruments and Controls" (approximately 360 sheets) (Ref. 83). These drawings show the location of each panel in the plant, the identification and physical arrangement of the instruments on the panel, the schematic piping from the process lines and equipment to the panel, and the schematic piping of the instruments on the panel. In some cases, the drainage piping is shown schematically; in others, the drainage is identified as CRW (clean radwaste) or DRW (dirty radwaste) and the piping is left to the discretion of the field. Frequently, the drainage piping terminates on the panel and is not shown connected to the plant drainage system. Therefore, it was considered necessary to walk down the plant and inspect the drain connection of each panel. A total of 446 hot instrument panels are shown on the drawings. The inspection data for these panels are tabulated in Table 18, Attachment D. These data are summarized as follows:

- 152 hot panels have drains, but the drains are not connected to a sump.
- 111 hot panels have drains connected to an equipment drain sump; 110 by closed piping and one by an open standpipe.
- 73 hot panels have drains connected to a floor drain sump.
- 53 hot system panels have no drains because their connection to the system is electrical.
- 22 hot system panels shown on the drawings were either not used or could not be found at the locations shown. (Note: No CATD was written here because reconciliation of As Built drawings as a separate subject is addressed in Subcategory Report 206.00)
- 12 hot panels which have piping or tubing connections to a hot system have no drains.
- 6 hot panels have drains connected directly to the condensers.
- 4 hot system panels have no drains because they are connected to the system by sealed capillary.
- 4 hot panels have drains connected to a station sump.
- 3 hot panels have drains connected to the Offgas Treatment Building sump.

- o 3 hot panels were not accessible at the time of the walkdown because of contamination related to modification work.
- o 1 hot panel drain connection passed into a floor sleeve but could not be traced further.
- o 1 hot panel drain is connected directly to the chemical waste tank.
- o 1 hot panel drain is connected to the Radwaste Evaporator Building floor drain sump by an open funnel drain.

Sample Sinks

The sample sinks are described by the 47W448-series drawings, "Sampling and Water Quality System," sheets 1 through 20 (Ref. 83). These drawings show the location and physical arrangement of the sinks, and the schematic piping from the sample point to the sink and from the sink to the plant drainage system. The drawings show there are 53 hot sample sinks. Some sinks are identified by an instrument panel number, others are not. The drain connection for each hot sink was inspected by a walkdown. The inspection data are tabulated in Table 19, and are summarized below:

- o 30 hot sink drains are connected to a floor drain sump: 22 by a closed connection, 6 by a funnel drain, and 2 by draining for approximately 12 inches across the floor to a floor drain.
- o 6 hot sink drains are connected to an equipment drain sump.
- o 6 hot sinks (the hydrogen analyzers) have no drains.
- o 4 hot sink drains pass into a floor sleeve but could not be traced further.
- o 3 hot sink drains are valved but not connected to a sump.
- o 2 hot sink drains are connected directly to the chemical waste tank.
- o 2 hot sinks could not be found at the locations shown on the drawings. (Note: No CATD was written here because reconciliation of As Built drawings as a separate subject is addressed in Subcategory Report 20600)

Drains Not Connected to a Sump

One hundred fifty-two hot instrument panels and three hot sample sinks are not connected to a sump. The drain connection of each instrument on these panels is valved, and frequently the lines from the drain valves are manifolded. The ends of the manifold are normally valved, plugged, or capped, but occasionally one or both ends of the manifold are left open, or closed with a plastic cap or mastic and tape. When it is necessary to drain these panels or sinks, the drainage must be collected in a portable container. An additional twelve hot panels have piping or tubing connections but no drains. If it is necessary to disconnect the piping or tubing to these panels, the drainage must similarly be collected in a portable container. As was observed in Nuclear Safety Review Staff (NSRS) Investigation Report I-85-921-SQN (Ref. 59), with this arrangement "the possibility of draining onto the floor does exist. However, this [is] not done as no informed technician would drain contaminated fluid on the floor and risk contaminating himself or others while calibrating or performing maintenance on instruments." However, reasonable questions as to health physics practices are raised by the presence of these hot panels which require draining, but have no permanent connection to the plant drainage system.

Personnel Exposure

While a BWR like BFN admittedly has more areas in which personnel may be exposed to contamination/radiation, it is also true that increased access control, shielding design, and health physics practices are in place at BWRs. Even though some exposure potential seems to exist from the panel drains listed above, it appears that, based on BFN's operating history as found in Nuclear Power Experience, unwarranted exposures have not in fact occurred.

Release Control

Most hot instrument panel and sample sink drains connected to the gravity drainage piping use a closed type connection where the piping is continuous from the instrument or sink to the sump. This type of connection presents no opportunity for overflow of wastewater or venting of entrained gases. A few hot instrument panel and sample sink drains use open standpipe or open funnel drain connections which do present an opportunity for wastewater overflow or entrained-gas venting.

Where hot instrument panel and sample sink drains are connected to a floor drain sump by gravity piping, the piping also connects to floor drains. These floor drains contain no backwater (check) valves and are not trapped, so there is an opportunity for wastewater overflow or entrained-gas venting even if the instrument panel or sample sink connection to the gravity piping is closed.

Summary of BFN Evaluation

From a detailed review of the drawings, it is evident that the drainage from all hot panels, except that directed to the station sumps, is pumped to the waste collector tank or the floor drain collector tank (both in the radwaste system) for treatment. Drainage from the station sump is normally released by pumping to the condenser circulating system or the yard drainage system. If appropriate, however, drainage from the station sump is pumped to the floor drain collector tank of the radwaste system for treatment. Discharge of any wastewater after treatment is subject to monitoring and is under administrative control. No drainage in the BFN plants is released to the environs without monitoring and, if necessary, treatment. However, the concern was deemed valid as stated for BFN. There are cases where potentially radioactive panel drains are routed into the floor drains instead of closed tanks.

4.5 Circulating Water - Element 229.3

4.5.1 Overview

The concern deals with flow measurement utilizing special instrumentation in a nonsafety pipe that, itself, has had a unique history. As such, the problem is limited to WBN. The causes for the problems with the Watts Bar cooling tower blowdown flow instrumentation all relate to either site topography or construction problems (see Sections 4.5.2 through 4.5.4). The history of power operation of the Sequoyah and Browns Ferry plants suggests that the comparable instrumentation for those plant has performed adequately. It is perhaps too early to determine whether the comparable instrumentation at Bellefonte will operate satisfactorily.

4.5.2 Operation of Flow Instrumentation

Proper measurement of the flowrate of the condenser circulating water (CCW) blowdown to the river (reservoir) is necessary for several reasons. The control function of the flow instrument is stated in WBN FSAR Section 10.4.5.5 (Ref. 85) as follows:

> "Since low level radioactive liquid waste from the Waste Disposal System and, at times, steam generator blowdown* are discharged into the cooling tower blowdown, provisions must be made to isolate these discharges when adequate dilution does not exist. Therefore, a flow element is provided in the CCW blowdown line immediately upstream of the diffusers. If there is not at least 20,000 gpm passing through the blowdown line, valves in the discharge lines from the two waste sources are automatically closed."

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* The Liquid Waste Processing System collects and processes potentially radioactive wastes for recycle to the Reactor Coolant System or for release to the environment via the cooling tower blowdown line. The steam generator blowdown and Liquid Waste Processing System effluents are monitored continuously for radiation. A high radiation alarm will automatically close valves, thereby isolating these systems from the cooling tower blowdown line.

A second reason for proper flowrate measurement is to ensure compliance with the Watts Bar Nuclear Plant National Pollutant Discharge Elimination System (NPDES) permit, which has been publicly noticed and is currently in draft form:

> "Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements [is] consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from the true discharge rates throughout the range of expected discharge volumes." (Ref. 84)

When it becomes effective, this permit will require continuous monitoring of the flow from the diffuser discharge to the river (Attachment C to NPDES permit, page I-1 and Ref. 84).

The flow instrument also serves as a diverse means, through valve position indication, of ensuring that blowdown to the river has been terminated as required during occurrences of low blowdown flowrate (as stated above) or of insufficient river flowrate. As stated in WBN FSAR Section 10.4.5.5 (Ref. 85):

> "Whenever river flow drops below 3,500 cfs, it will become necessary to withhold CCW blowdown to avoid violation of thermal or chemical discharge standards."

As shown in flow diagram 47W831-1 (Ref. 86), when the flowpath to the river outfall is isolated, the cooling tower blowdown is rerouted to the holding pond. This relates to Concern IN-85-281-001 which parenthetically mentions the holding pond in connection with the diffuser to the river.

No safety-related functions are performed by the flow instrument (Ref. 87).

The portions of the flow instrumentation of concern are (1) the flow element and (2) the flow transmitter.

A flow element is a device located in the process pipe that senses the flow velocity of the process fluid (in this case, condenser circulating water blowdown). The flowrate of a fluid in a pipe is not uniform throughout the pipe cross-section. Because of pipe wall friction, the flowrate of fluid in the center is higher than that near the wall. Other variations in this "flow profile" may be introduced by other hydraulic effects, such as turbulence caused by nearby fittings, etc. Thus, the flow element must be designed to account for such flow variations.

FE 27-98 is an "averaging pitot tube" type of flow element, commonly referred to by its Dietrich Standard Corporation trade name of "annubar," which averages the local flowrates at several points across the process pipe. The section of the process pipe in which the annubar is located is a low spot and remains full of water, even during no-flow conditions. The annubar consists of two sensing probes installed in the process pipe at right angles to the process fluid flow direction. Along the length of the first (upstream) probe are several "impact" holes facing the flow direction. These impact holes sense the total pressure at each sensing point. The impact holes are interconnected, and the internal tube of the upstream probe is placed so that it "averages" the pressures sensed at each hole. The second probe faces downstream and senses the static pressure in the process system. The difference between the average total pressure and the static pressure is a measure of the average fluid velocity.

The high and low pressure probes of the flow element are connected to the flow transmitter by sensing lines. The flow transmitter, FT 27-98, converts the pressure difference to an electrical signal which can then be used for metering and control. For the flow transmitter to function properly, the sensing lines must always be full of water.

4.5.3 . Sensing Line Water Column Separation

Issue "a" addresses the concern that there is insufficient static pressure for proper flow instrument operation. This is interpreted to mean that the transmitter is too high, when compared to the static pressure in the process pipe, to ensure that the sensing lines remain filled "solid" with water. The Employee Response Team (ERT) Investigation Report associated with Concern IN-85-281-001 (Ref. 92) states in part:

> "During maximum flow condition it is estimated that the static head at the annubar will be only 40" of water. The transmitter for this flow element (FT-27-98) is located 48" above the annubar in the manhole 'A.' Due to the lack of static head it is not possible for the sensing lines to stay filled solid with water."

(Note that the difference between the static head [40 inches] and the flow transmitter height [48 inches] is 8 inches. This correlates to the statement in EC IN-85-142-008, viz.: "Gauge should have 11", however it only reads 3"." The difference in gauge levels is also 8 inches.)

The Failure Evaluation/Engineering Report (FE/ER) for NCR W-250-P, R0 (Ref. 87), which was written to evaluate the flow instrumentation concerns, asserts that:

"(1) the transmitter-sense line assembly design and installation is adequate and meets operability requirements, and (2) other sense line fill methods which are often used, to our knowledge, have not been attempted. Therefore, since the transmitter-sense line assembly has not been placed in an operating configuration, no failure has occurred and no failure is hereby assumed. However, OE acknowledges the present installation will probably require increased maintenance [sic] since all fittings will have to be sealed properly to prevent in leakage of air."

The disposition of the NCR was also addressed by TVA Engineering Project in a memorandum, as follows:

"We agree the transmitter's sense lines can not be filled by process static pressure. To our knowledge, this is the only fill method that has been attempted. Other methods are available and should be used before declaring the loop non-functional. OE recommends that filling should be attempted using system dynamic pressure (during full discharge to the river) or by closing the flow sensor isolation valves and manually filling the lines from the transmitter. Care should be taken to properly seal all fittings to avoid the in leakage of air" (Ref. 88).

The Failure Evaluation does not appear to address the specific concern in the ERT Investigation Report. The FE/ER alludes to the possibility that not all possible methods of filling the sensing lines had been attempted. Part 6 of the FE/ER, "Cause of the Nonconformance," states in part:

"The problem described in the NCR is the inability to properly fill a sense line assembly by a single method, e.g., allowing the process medium's static pressure to provide force to purge the sense lines."

It is agreed that other filling methods should have been attempted. It is not clear, however, that, once filled, the sensing lines would remain that way. Air leaking into the flow instrument would be expected to result in water column separation because the height of the transmitter exceeds the static head of the water in the process pipe.

Although the available documentation is silent, further attempts to fill the sensing lines must have been unsuccessful, because on February 21, 1986, Field Change Request (FCR) NP-1165 (Ref. 89) was initiated, stating the following change description:

"1. Added Gould submersible transmitter in place of missing Robertshaw transmitter. 2. Modified square rooter input to 4-20 mA to match new transmitter. 3. Accumulator columns were added to damp out water oscillations due to the high and low side of the transmitter. 4. Repositioned transmitter to just above diffuser pipe due to low static pressure head. '<u>This is the resolution to NCR W-250-P.</u>'"

An addendum to the FCR states, in part:

"The following items need to be done although there are no drawings showing permanent installations to be revised.

1) Permanently mount Gould transmitter in manhole at the level it is temporarily mounted. (This is due to a much lower static pressure head than originally thought.)

2) In place of polyflo lines permanently install sense lines with their accumulator as per temporarily installed system. (Accumulators were installed to damp out water surges in diffuser piping...."

(No further information is given concerning the "missing" Robertshaw transmitter, the "polyflo" line, or the accumulator.)

Items 1 and 2 of the Addendum to (FCR) NP-1165 have been completed under Workplan F-NP-1165-1 (Ref. 90). Wiring changes are to be done under ECN-6431 (Ref. 91) (see Section 4.5.4).

4.5.4 Protection of Transmitter Against Local Flooding

The ERT Investigation Report for Concern IN-85-281-001 (Ref. 92) states, in part:

"During this investigation it was determined that the manhole 'A' has been flooded with water several times. It has been determined that the instruments [sic] FT-27-98 for the flow diffuser and another measuring instrument RTD (TT-27-99) are not in water tight enclosures, nor are they designed to function when submerged. As a result, NCR W-251-P has been written to correct this condition."

A specification data sheet from the purchase order for the replacement (Gould, Inc.) transmitter is attached to FCR NP-1165. This data sheet specified an NEMA 6 enclosure for the transmitter; a footnote to this requirement states: "Transmitter must remain functional when submerged in up to three ft of water."

Installation of a submersible flow transmitter closer to the process pipe resolves the part of issue "a" (see Att. B) related to poor location of the flow instrument. In addition, the manhole has been caulked and the sump pump repaired to maintain a dry manhole.

The measuring instrument RTD (TT-27-99) referred to in the ERT Investigation Report continuously monitors the discharge temperature. This is required by the NPDES permit (Ref. 84, page I-1 of Attachment C); however, "there are no nuclear safety implications which would result due to the failure of this device" (Ref. 93).

4.5.5 Matching Flow Element Length to Process Pipe Diameter

At present, the flow element is not properly matched to the process pipe because the flow element (annubar) was intended by the manufacturer to be installed in a 72-inch-diameter process pipe, whereas the actual process pipe diameter is 66 inches. This issue was not explicitly raised in any of the four employee concerns. EC IN-85-889-002 does state, in part, that "the pipe line is 4'-6" diameter." However, the EC does not indicate that the stated pipe line diameter contributes to the alleged inadequacy of the flow monitoring instrument.

Nevertheless, the ERT Investigation Report for Concern IN-85-281-001 reveals the following (Ref. 92):

> "A review of drawings 47W831-1 and 17W303-4 show [s] the location of flow element FE-27-98 in a 66" fiberglass pipe which is surrounded by a 72" corrugated metal pipe. The supplier, Dietrich [sic] Standard Corp., drawing #83520 shows the element is designed for use in a 72" annubar [sic] not a 66". All calculations are for a 72" line."

(Note that the diameter of 4'-6" quoted in EC IN-85-889-002 is in error. The actual diameter is discussed below.)

As described in Section 4.5.1 of this report, an annubar-type flow element is used to generate an average process fluid flow velocity signal by placing several pressure-sensing "impact" holes along the length of the upstream probe of the flow element. This is done to account for local variations of process fluid flowrate across the pipe diameter. If the flow element (annubar) length is not properly matched to the process pipe diameter, the "impact" holes may not be in their optimum configuration to generate a representative, average flowrate signal.

The only discussion of this issue in the FE/ER for NCR W-250-P (Ref. 87) is the following:

> "The process line is a 72" diameter corrugated steel pipe which is embedded in the yard. The flow element (O-FE-27-98) is mounted through the top of the pipe and spans the entire diameter of the pipe."

OE did not address the question of whether the pipe that actually contains the process fluid is the 66-inch-diameter fiberglass pipe, or whether the 72-inch corrugated steel pipe merely serves as a conduit for the 66-inch process pipe. Thus, the FE/ER response did not address this adequately. NSRS reached the same conclusion in the Corrective Action Response Evaluation Report IN-85-281-001 of July 25, 1985, which states in part: "The FE/ER for NCR W-250-P fails to address the annubar located in the 66" vs. 72" pipe."

4.5.6 Main Process Piping Background

The apparent confusion over the actual diameter and material of the cooling tower blowdown process pipe can be explained by a brief review of the history of this section of piping.

The original piping was 72-inch-diameter corrugated metal pipe with a bitumen (asphalt) liner. After delivery to the site, this piping was left out in the yard, unprotected. Consequently, the lining cracked from exposure to the sun. After pipe installation (this is buried yard piping), heavy equipment was run over the piping, apparently resulting in further damage. When water was first admitted into the pipe, it leaked profusely causing ponding in the yard. Chunks of asphalt passed through the diffusers into the river. Consequently, TVA sought to stop the leakage by inserting a 66-inch-diameter fiberglass pipe inside the corrugated metal pipe. After the 66-inch-diameter fiberglass pipe was inserted, TVA recognized that the annubar FE 27-98 was no longer properly sized to fit the pipe diameter, so TVA site personnel trimmed the annubar to fit. Upon learning that the trimmed annubar would not work properly, TVA planned to procure and install a new annubar sized by the manufacturer for the fiberglass pipe insert. However, as discussed below, this plan was subsequently changed, and these actions were not carried out.

The fiberglass pipe insert did not completely eliminate the leakage; therefore, this section of piping is to be replaced with a concrete pipe (72-inch- diameter). The pipe replacement has been partially implemented on the design drawings. The piping layout drawing, 17W303-2, R8; the piping profile, 17W303-4, R8; and the detail for the manhole and monitor, 17W303-5, R0 (Ref. 94), show that the annubar is located in a 72-inch concrete (unlined) pipe. (These changes were made pursuant to Engineering Change Notice [ECN] 6455 [Ref. 95], which was incorporated in the referenced drawings on September 25, 1987).

The concrete replacement piping has been purchased and delivered. It is scheduled to be installed in spring/summer of 1987 and is required to be installed before initial fuel loading. The corrugated metal manhole in which the subject flow instruments are located will also be replaced with a concrete manhole to help keep out groundwater.

The current revision of the flow diagram 47W831-1 is R18. WBN FSAR figure 10.4-2 was prepared from R12 of this drawing. Both revisions still show the cooling tower blowdown pipe diameter in the vicinity of FE 27-98 as 66 inches. (This is not a discrepancy, because the flow diagram depicts the current, as-installed piping configuration.)

Because of the piping replacement, the plan to install a new annubar to fit the fiberglass insert pipe has been abandoned. TVA now intends to replace the annubar with a new one when the concrete pipe is installed. ECN 6455 Data Sheet 4 (02/28/87) will implement replacement of the annubar flow element.

The Dietrich Standard Corporation drawing of the annubar flow element (Ref. 96) shows that the original flow element FE 27-98 is annubar "type 766," special manufacture for a 72-inch inside-diameter pipe. This drawing portrays the annubar installed vertically in the pipe, entering from the bottom. Operations Engineering addressed the top entry in its evaluation of WBN NCR W-250-P as follows:

> "We acknowledge and are aware of the manufacturer's recommended flow sensor orientation. The existing mounting is acceptable and is often used. Also, since the process pipe is embedded and accessible only from the top, the existing installation is the only possible one."

Because, as is shown in the Dietrich Standard Corp. drawing, the annubar's "impact" and static-pressure sensing holes are spaced equidistant radially from the pipe centerline, it is immaterial whether the annubar enters from the top, bottom, or side of the pipe. Therefore, OE's response was correct, as far as it went. However, nowhere in the NCR W-250-P or in the FE/ER report is it mentioned that a 66-inch-diameter fiberglass pipe had been inserted and that the annubar had been trimmed to fit. Furthermore, there is no mention of TVA's plans to replace the existing pipes with a concrete pipe and to replace the new annubar with a new 72-inch one.

4.5.7 Summary of Evaluation

The concern that water column separation occurs because of insufficient static pressure was valid when expressed because TVA had not yet ascertained whether the flow transmitter sensing lines could be filled and maintained in a "water-solid" condition. Subsequent corrective action consisted of lowering the flow transmitter (i.e., moving it closer to the flow element). Therefore, this part of the concern has been resolved satisfactorily.

The concern with respect to the "poorly located" flow transmitter was valid when expressed because TVA had not then completed actions to resolve local manway flooding. Subsequent corrective action consisted of caulking the manway, repairing a sump pump, and replacing the transmitter with a submersible one. Further corrective action, while not required to resolve this issue, will consist of replacing the manway with a precast concrete manway. Therefore, this part of the concern has been resolved satisfactorily, pending rewiring of the transmitter under ECN 6431 (08/15/86).

The inadequacy of the present flow monitoring instrument was valid when expressed in IN-85-889-002. ECN 6455 Data Sheet 4 (02/28/87) will implement replacement of the annubar flow element (FE 27-98) after the new 72-inch concrete blowdown line is installed.

4.6 Control Air System - Element 229.5

4.6.1 Overview

The concern alludes to a guillotine pipe break that may result in loss of compressed air to support safety systems functions. WBN concern IN-85-348-002 was raised and investigated for WBN. Because SQN has a compressed air system design similar to that at WBN, the concern was addressed for SQN as well. BLN has an air system that is sufficiently analogous to SQN and WBN to warrant investigation as well. BFN does not use safety grade air systems.

The concern does not specify a location for the "guillotine pipe break" in question, so this evaluation was based on its potential occurrence in either the Station Control and Service Air (SCSA) or the Auxiliary Control Air (ACA), inside or outside containment. The concern also does not clearly indicate whether this pipe break was considered to be an initiating event or to be subsequent to some other initiating event. Therefore, the evaluation considered both cases.

TVA reviewed the SQN ACA subsystem during the period from 11/27/85 to 12/20/85. Seven discrepancy reports (SQ-DR-86-02-017R through -022R and -032R) were issued as a result of this review and dealt with such subjects as maintenance and testing records. None of these related to the subject of the concern. The review report concluded that "the ACA System has been designed, maintained, and tested such that it can perform its intended safety function; that is to supply air to vital equipment under all conditions."

4.6.2 SQN and WBN System Description

System Description

The term "control air system" has no formal status for SQN. As indicated in the SQN FSAR, the overall system is referred to as the Compressed Air System, which consists of two subsystems, SCSA and ACA. The term "control air" may apply either to that portion of the SCSA not dedicated to service air or to the ACA.

The SCSA includes five motor-driven air compressors, any two of which can handle all control air requirements under normal plant operating conditions. The ACA consists of two completely redundant sets of compressed air supply equipment and associated supply piping. ACA serves all safety-related plant components whose active functions require control air. SCSA serves certain safety-related components whose active functions are not safety-related. Therefore, the SCSA is nonsafety-related and the ACA is safety-related.

The ACA air compressors are in a standby condition during normal plant operation. The ACA receivers are normally charged from the cross-connected SCSA. On indication of low pressure in the SCSA, the ACA compressors are automatically started, and, on further decrease in system pressure, both trains of the ACA are automatically isolated from the SCSA by control valves.

4.6.3 Design Criteria

Criteria applicable to pipe breaks outside containment as initiating events are defined in SQN Design Criteria SQN-DC-V-1.1.11 (Ref. 97) and WBN Design Criteria WB-DC-40-31.50 (Ref. 246). Pipe break analyses inside containment for SQN are covered separately in Design Criteria SQN-DC-V-2.13 (Ref. 98). These documents define "high energy" piping as that which normally operates at pressure and temperature above 275 psig and 200°F. "Low energy" piping is that which operates at either a pressure or temperature below these values. These documents require that both "guillotine breaks" and "critical cracks" be assumed (separately) in high energy piping but that only "critical cracks" be assumed in low energy piping. The opening size of a critical crack is stated to be one-half the inside pipe diameter in length and one-half the pipe wall thickness in width.

Another criteria subject possibly related to the concern is the distinction between failures which are directly caused by the initial break and "single failures" which must be assumed in evaluating the plant safe shutdown capability in response to the initial break. The regulatory criteria (Ref. 101) define the initiating event as including those secondary effects which are likely to occur as a direct consequence of the initial pipe break. These may include various failure modes of piping in the vicinity of the initiating pipe break location. An additional component failure referred to as the "single failure" must be assumed in those systems utilized in accomplishing safe shutdown in response to the initiating event.

All of the foregoing criteria are consistent with NRC requirements applicable to plants contemporaneous with SQN and WBN (Ref. 99).

4.6.4 Analysis

As indicated earlier, pipe breaks can be either initiating or subsequent events. There can also be a subset of initiating events, which includes those events likely to occur as a direct result of the initiating events, such as an additional failure of a nearby pipe. These variations are covered in the following paragraphs.

Pipe Break as an Initiating Event

As described in their FSARs (Refs. 100 and 109), for the majority of the SQN and WBN SCSA and ACA piping the design pressure is 105 psig and the design temperature is 100°F. The only exception to these values is in the air compressor discharge lines up to their air coolers, for which the maximum design temperature is 260°F at SQN and 244°F at WBN. The ACA compressor discharge lines are not pressurized during normal plant operation, and they fall into a category that the criteria documents exempt from the "high energy" definition and classify as "low energy." Therefore, the only control air piping falling under the "high energy" definition, and thus requiring guillotine pipe break assumptions, is the SCSA compressor discharge line up to the aftercoolers. No guillotine breaks need be assumed in the safety-related ACA. A guillotine break in a SCSA compressor discharge line will not cause loss of system function as each of the compressors are separated from the main system headers by check valves.

The occurrence of a critical crack anywhere in the normally pressurized portions of SCSA and ACA would be unlikely to cause a loss of system function because of the size and quantity of SCSA compressors. Table 9.3.1-1 of the respective plant FSARs (Ref. 100 for SQN and Ref. 109 for WBN) lists the SCSA capacity as 2440 scfm for SQN and 2464 scfm for WBN. The criteria do not require an assumption of loss of offsite power for such events (with subsequent loss of all SCSA compressors) as this assumption is required only if the initiating event is likely to be the direct cause of the loss of offsite power. If the critical crack were to occur in one of the ACA trains and all SCSA compressors were to be lost, the redundant, separated ACA train would be available to support plant shutdown.

Pipe Break as a Subsequent Event

Another possible interpretation of the employee concern is that it relates to a control air failure subsequent to some other initiating event. This type of failure would constitute a "single failure" as defined by the NRC in 10 CFR 50, Appendix A (Ref. 101). Design Criteria SQN-DC-V-2.16 (Ref. 102) covers the same subject in greater detail. A pipe break would constitute a "passive" failure. Passive failures are not defined in the SQN design criteria, but current industry practice, as documented in the Single Failure Criteria standard ANSI/ANS-58.9 (Ref. 103), is to consider only credible failures such as seal or gasket leakage in piping systems. Furthermore, neither SQN nor WBN criteria require consideration of passive failures within the first 24 hours following an accident. After this period, active function of components served by ACA should not be required. However, even if it were required, component functionality is assured through use of the redundant ACA train.

Pipe Break Caused by the Initiating Event

As indicated previously, the direct consequences of a pipe break event must be considered a part of the initiating event.

As a result of field evaluations to assess compliance with separation criteria, six nonconformance reports (NCRs) as referred to in Reference 104, were issued on SQN in 1981 identifying inadequate separation of high energy lines and the essential (ACA) headers both inside and outside containment. Interactions noted in locations outside containment were subsequently found to be acceptable. A review of these potential interactions was documented in calculation number NEB 810811274, R1 (Ref. 104). The review concluded that the interactions were acceptable, based on the fact that the ACA services lost within containment were not required to accomplish safe shutdown following those particular pipe breaks. However, this analysis did not account for the overall effects of the ACA piping failure on the availability of ACA when considering a single failure in the unaffected train of ACA. These effects were not identified until late in 1986, and documented in SCR SQNMEB86121 (Ref. 105) which, during preparation of essential calculations (Ref. 106), showed that the affected ACA train cannot be isolated prior to the occurrence of unacceptable pressure loss in the system. A single failure in the unaffected train would then result in loss of system function, possibly preventing safe shutdown.

In July 1987, additional unacceptable ACA system/high energy pipe break interactions, outside primary containment, were identified as a result of an NRC inspection. TVA, in the corrective action plan closure for the SQN 229.05 element report (Ref. 107), committed to keep the SCR listed in the preceding paragraph open to address this issue.

WBN reviewed the likely direct consequences of pipe breaks inside and outside containment from such effects as pipe whip and jet impingement. This review indicated that there is adequate physical separation between safety-related air piping and high energy piping inside and outside the WBN containment. The review is documented in TVA Reports CEB-77-39 and CEB-77-55, respectively (Refs. 110 and 111). This result differs from that found at SQN, where some ACA piping within containment was not adequately separated from high energy piping.

A minor problem developed during this evaluation. The pipe break report CEB-77-39 contained no mention of the ACA subsystem. Instead, the service air (SA) subsystem was identified as a potential target to be reviewed for the effects of high energy pipe breaks. In the detailed tabulations of targets reviewed, all references to air lines were identified "SA." Since the SA subsystem is not safety related, it would not be expected to be included in the scope of this review. On the other hand, ACA would be expected to be included. In response to a request for information clarifying this situation (Ref. 112), TVA confirmed (Ref. 113) that ACA was misidentified as SA in the TVA report.

Summary

The evaluation team found that there is sufficient capacity, redundancy, and isolation provision in the SQN and WBN control air systems to support systems required for safe shutdown for all design basis events originating within the ACA. In accordance with NRC criteria, no guillotine break assumptions are required in the safety-related ACA subsystem. However, TVA's and NRC's reviews of high energy pipe breaks at SQN have identified a number of unacceptable interactions that could cause loss of ACA function in the event of a single failure in the unaffected ACA train. This was not the case at WBN.

Although concern IN-85-348-002, as expressed, is not technically valid, a peripheral issue regarding the physical separation of ACA piping from high energy piping within containment was raised. Similar problems have been raised by the NRC recently, and will be addressed by TVA's normal procedures for handling conditions adverse to quality. Resolution of these additional problems transcends the scope of this evaluation and, therefore, was not included as a corrective action plan.

4.6.5 BLN Evaluation

Comparison With SQN and WBN Reviews

For WBN and SQN, the main issue was the functionality of the safety-related auxiliary control air (ACA) subsystem. The analogous system for Bellefonte Nuclear Plant (BLN) is the essential air system (EAS). The BLN EAS is similar in configuration to the WBN and SQN ACAs, except that at BLN only one set of air compressors, which are safety-related, is provided for all systems. At WBN and SQN, a separate set of safety-related ACA compressors is provided to supplement the nonsafety-related station air compressors.

BLN System Description

As indicated in the BLN FSAR (Ref. 114), the overall system is referred to as the compressed air systems. These consist of the control air, service air, and essential air systems.

The EAS includes four motor-driven air compressors, any two of which can handle all control air requirements under normal and accident plant operating conditions. The EAS consists of two completely redundant sets of compressed air supply equipment and associated supply piping. The EAS serves all safety-related plant components whose active functions require control air.

Design Criteria

Criteria applicable to pipe breaks inside or outside containment as initiating events are defined in BLN Design Criteria N4-50-D720 (Ref. 115). This document is consistent with the criteria previously outlined on SQN and WBN.

The previously outlined SQN and WBN criteria making a distinction between failures that are directly caused by the initial break and "single failures," which must be assumed in evaluating safe shutdown capability in response to the initial break, also apply to BLN.

Analysis

Pipe breaks can be either initiating or subsequent events. There is also a subset of initiating events, which includes those events likely to occur as a direct result of the initiating events, such as an additional failure of a nearby pipe. These variations are covered in the following paragraphs.

- Pipe break as an initiating event - For most of the BLN EAS piping, the design pressure is 125 psig and the design temperature is 150°F. The only exception to these values is in the air compressor discharge lines up to the air coolers, for which the maximum design temperature is 325°F (Refs. 247 and 248). Therefore, the only EAS piping falling under the "high energy" definition, and thus requiring guillotine pipe break assumptions, is the compressor discharge line up to the aftercoolers. A guillotine break in a compressor discharge line will not cause loss of system function because each compressor is separated from the main system headers by a check valve upstream of the system air receivers.

  The occurrence of a critical crack anywhere in the EAS would be unlikely to cause a loss of system function because of the size and quantity of system compressors. Paragraph 9.3.1.2.1 of the BLN FSAR indicates the capacity of each compressor to be 720 scfm at 110 psig. The criteria do not require an assumption of loss of offsite power for such events (with subsequent loss of all compressors); this assumption is required only if the initiating event is likely to be the direct cause of the loss of offsite power. If the critical crack were to occur in one of the EAS trains the redundant, separated EAS train would be available to support plant shutdown.

- Pipe break as a subsequent event - Another possible interpretation of the employee concern is that it relates to a control air failure subsequent to some other initiating event. This type of failure would constitute a "single failure" as defined by the NRC in 10 CFR 50, Appendix A. A pipe break would constitute a "passive" failure. Passive failures are not defined in the BLN design criteria, but current industry practice, as documented in the Single Failure Criteria standard ANSI/ANS-58.9 (Ref. 103), is to consider only credible failures such as seal or gasket leakage in piping systems. However, even if a complete pipe break were assumed, BLN safety system functionality is assured through use of the redundant EAS train.

- Pipe break caused by the initiating event - As indicated previously, the direct consequences of a pipe break event must be considered a part of the initiating event. There is no EAS piping inside primary containment at BLN. BLN reviewed the likely direct consequences of pipe breaks outside containment from such effects as pipe whip and jet impingement; the review is documented in TVA Report CEB-77-10 (Ref. 116). This review indicated that there was generally adequate physical separation between EAS piping and high energy piping outside the BLN containment. However, in certain areas, design modifications were necessary to prevent unacceptable interactions. These were as follows:

- Main Steam Valve Rooms - The EAS serves main steam isolation valves (MSIV) and modulating atmospheric dump valves (MADV), required for safe shutdown in these rooms. Certain pipe breaks were found that could disable both EAS trains from a single event. For the MSIVs, the solution was to provide a second air supply, from the control air system, to each MSIV, physically separated from the EAS supply. In addition, air accumulators, separated from the EAS headers by check valves, were provided for each MSIV. For the MADVs, an alarm was provided to indicate loss of EAS, following which the operator would be able to switch to manual valve control.

- Turbine Driven Auxiliary Feedwater Pump Room - The EAS serves steam generator level control valves and a pressure control valve in the auxiliary feedwater (AFW) pump turbine steam supply line in this room. These valves are required for safe shutdown. Also, in this case, certain pipe breaks were found that could disable both EAS trains from a single event. The solution was to provide accumulators for each of the individual control valves. However, for longer term control of the steam generator level control valves in the AFW turbine driven pump discharge lines, a manual cross-tie was provided to allow a supply of air from accumulators in either train.

- Auxiliary Building Pipe Trench/Chase - It was found that the steam supply line to the turbine-driven AFW pump and the EAS B train supply piping had been routed in the same pipe trench or chase, which unnecessarily exposed it to pipe break effects. The EAS line was rerouted to avoid this exposure.

Summary of BLN Evaluation

BLN was found to have sufficient capacity, redundancy, and isolation provision in the compressed air systems to support those systems required for safe shutdown for all design basis events originating within the EAS. In accordance with NRC pipe break criteria, no guillotine break assumptions were required for the BLN EAS.

The evaluation team also found that there are no unacceptable potential interactions between high energy piping and the EAS piping.

4.7 Water Quality System - Element 229.6

4.7.1 Overview

The CI is concerned about "the potential [of System 43] to contain radioactively contaminated water under postulated accident conditions." This concern, in conjunction with a presumed absence of "isolation/drain valves for controlled draining of effluent," indicates a materials handling issue that does not adequately consider the potential personnel exposure.

Concern IN-85-348-003 is directed to WBN System 43 piping in the pipe chase at WBN elevation 713 feet. The report interprets "pipe chase" to include the adjacent hot sample room. This room contains the major items of System 43 equipment that handle materials with radioactive inventory during normal plant operation and is the destination of the System 43 piping in the pipe chase that carries radioactive inventory. Because the concern is specifically directed to potentially radioactive System 43 piping in the pipe chase and because this piping is normally the most radioactive System 43 piping, this report does not consider System 43 piping in other areas or elevations in the Auxiliary Building or in the Turbine Building.

Although raised for Watts Bar unit 1, Concern IN-85-348-003 is applicable to SQN because the primary and secondary process systems, the sampling and water quality system (System 43), and the physical layout at SQN are essentially the same as those at WBN. The pipe chase equivalent elevation at SQN is elevation 690 feet.

The evaluations at SQN and WBN were conducted by documentation research and physical walkdown of the areas in question. The following applies to both plants.

4.7.2 System 43 Description

The System 43 design basis is established in Section 9.3.2.1 of the WBN and SQN FSARs (Refs. 117 and 119 respectively). The SQN description states:

> "The sampling system is designed to obtain samples from the various process systems in each of the two units. The samples are obtained in the titration room, hot sample room, and locally (grab samples) for laboratory analysis. This system has no safety-related functions. During a Loss-of-Coolant Accident (LOCA), this system is isolated at the containment boundary. Sampling system discharges are designed to limit flows under normal operation and anticipated malfunctions or failure to preclude any fission product release in excess of the limits as stated in 10 CFR 20."

Samples are taken by extracting a small quantity of process fluid at the sample points. Samples are then transported through the System 43 piping to the appropriate System 43 equipment. At this equipment, the samples are either analyzed or isolated in a container (grab samples) for subsequent laboratory analysis.

According to Section 9.3:2.2 of the SQN and WBN FSARs, samples from primary process systems, which are radioactive, are routed to the cubicles in the hot sample room:

> " . . . for automatic analysis of such variables as pH and conductivity. These variables are indicated in the hot sample room and recorded in the titration room, except for evaporator condensate demineralizer pH samples which are recorded in the hot sample room. Any variable exceeding established limits is annunciated in the titration room. Radioactive grab samples are taken to the radiochemical laboratory for analysis.
>
> Boron concentration monitors (one per unit) are also located in the hot sample room. The RCS letdown is sampled continuously by the boron concentration monitor, indicated in the hot sample room, and recorded in the main control room. . . .
>
> The Gas Analyzer System [(one per plant) is also located in the hot sample room and] sequentially monitors 20 points in the Waste Disposal System and CVCS for hydrogen and oxygen concentrations in a nitrogen atmosphere. The concentrations are indicated, recorded, and alarmed at the analyzer".

4.7.3 Pipe Chase

The pipe chase is identified for SQN on Drawing 47W600-204 (Ref. 169) and for WBN on Drawing 47W600-6 (Ref. 64). The pipe chase is an irregularly shaped room, which lies adjacent to the hot sample room and abuts the outside wall of the Reactor Building. Piping that carries samples with radioactive inventory from the primary process systems within the containment to the sampling system equipment in the hot sample room passes through the pipe chase.

Access to the pipe chase is from the hot sample room. Access to the hot sample room is through locked doors. Both rooms are under decontamination control and, therefore, personnel in these rooms will be subject to health physics procedures.

4.7.4 Sampling Methods

The SQN and WBN FSARs explain the operation of the sampling system:

> "The sampling system is operated manually throughout the full range of power operations. . . . Prior to collecting a sample, each sample line is purged according to sample line length and diameter to ensure a representative sample is obtained. The sample volume is dependent upon the chemical analysis to be run" (Refs. 117 and 119, Section 9.3.2.2).

The sources of the samples that are sampled in the hot sample room were walked down and are tabulated in Tables 24 and 25 for SQN and WBN, respectively.

All samples are taken behind shatterproof glass windows. All cubicles are hooded and equipped with fans that vent through HEPA filters. Consequently, any radioactive gases released from the sample stream will not be vented into the hot sample room when the hoods are opened to remove the samples. Cubicles 1A and 2A, which contain the most radioactive samples, have 2 inches of lead shielding and provisions to take samples in lead-lined stainless steel cylinders. Valving is included for bypass blowdown of sample lines in Cubicles 1A and 2A. In other cubicles, sample lines are blown down directly into the sample sinks.

4.7.5 Isolation Capability

Section 9.3.2.2 of the SQN and WBN FSARs defines the requirements for isolation valves:

> "All sample lines originating within containment have air-operated isolation valves near the sample point and inside and outside containment for containment isolation. All sample lines [originating outside] containment have manual isolation valves, [except the volume control tank vent and RHR miniflow lines which have air-operated isolation valves]."

Note: The bracketed words appear only in the SQN FSAR. Isolation valves in sample lines originating outside the containment are also located near the sample point.

The design drawings were reviewed and the isolation valves for each sample line were identified. These data are tabulated in Tables 24 and 25, Attachment D, for SQN and WBN respectively. This review established that the design drawings reflect the FSAR requirements. In addition, the design drawings show isolation (block) valves at the inlet of each sample line to the sample cubicles, boron monitors, and gas analyzer. Additional isolation valves are provided in cubicles 1A and 2A and at the gas analyzer to permit removal of sample cylinders. The presence of the isolation valves shown on the design drawings has been confirmed by a walkdown (Refs. 118 and 120).

4.7.6 Drainage Capability

System 43 piping in the pipe chase at both WBN and SQN is drained through the sample cubicles, boron monitors, and gas analyzer in the hot sample room. Each module of cubicles 1A and 2A includes piping and valves that permit draining the sample line both around and through the sample cylinder. The modules that handle primary system samples are drained to the CVCS volume control tank, which permits recycling material not removed from the system in a sample cylinder. These modules are identified in Tables 24 and 25. The other modules of cubicles 1A and 2A are drained to the building drainage system. Each module of cubicles 1B, 2B, and 1C includes piping and valves that permit draining the sample line into the cubicle sink.

Each cubicle includes a sink inside the hooded and vented portion of the cubicle. Fluid that is discharged or spills into the sink flows by gravity to the building drainage system. The isolation capability of the building drainage system is described in the SQN evaluation for element 229.2, Section 4.4.1, which concludes that "potentially radioactive inventory will not be released [from the building drainage system] without proper monitoring and treatment [and] the potential exposure of operating personnel [to drainage with radioactive inventory] is consistent with . . . accepted health physics practices." This conclusion is equally applicable to WBN because of the similarity of the two plants.

4.7.7 Personnel Exposure

Since the sampling system handles samples of process fluids with radioactive inventory and is required to conform to 10 CFR 20, the following precautions have been taken to protect SQN and WBN personnel from exposure to radiation:

- "All sample lines . . . have . . . isolation valves near the sample point" (Ref. 117, Section 9.3.2.3) (Ref. 119, Section 9.3.2.2)
- "Sample lines from the RCS hotlegs contain a delay coil to provide 40-second sample transit time within containment . . . (allows for decay [of] N-16)" (Refs. 117 and 119, Section 9.3.2.3); $T_{1/2}$ = 7.1 seconds
- "All sample lines originating within containment have air-operated isolation valves . . . inside and outside containment for containment isolation" (Ref. 117, Section 9.3.2.3)(Ref. 119, Section 9.3.2.2)
- "Sample lines from RCS hotlegs . . . [have] a 20-second transit time from containment to hot sample cubicles (allows for decay [of] N-16)" (Refs. 117 and 119, Section 9.3.2.3)

- No System 43 equipment (other than piping) is located in the pipe chase
- Isolation (block) valves which meet the ASME Section III Code are provided at the panel connections
- "Cubicles 1A and 2A have a 2-inch lead shield behind the front plate of the cubicles" (Ref. 117 and 119, Section 9.3.2.3)
- "2-inch lead shielded [stainless steel] sample cylinders are available for use" in cubicles 1A and 2A (Refs. 117 and 119, Section 9.3.2.3)
- "All cubicles are designed to permit collection of a sample behind a shatterproof glass window" (Refs. 117 and 119, Section 9.3.2.3)
- "All cubicles have individual exhaust hoods and fans equipped with HEPA filters to ensure that any leakage other than noble gases will remain in the cubicle sink area" (Refs. 117 and 119, Section 9.3.2.3)
- Valves are provided to control discharge of sample fluid from the panels
- Panel drains are connected to the building drainage system (except for those modules that are drained to the CVCS volume control tank)
- Access to the hot sample room and pipe chase is controlled by locked doors
- Access to the hot sample room and pipe chase is under administrative health physics control

In addition, "all sample lines have the required [pressure, temperature, and flow] indicators, pressure throttling valves, [and] heat exchangers . . . to ensure plant operator safety when collecting samples" (Refs. 117 and 119, Section 9.3.2.3).

The SQN FSAR states that "sampling system discharges are designed to limit flows under normal operation and anticipated malfunctions or failure to preclude any fission product release in excess of the limits as stated in 10CFR20" and that "sample lines outside reactor containment [are] not considered hazardous because of their limited flow and nonessential nature." Similar commitments are made in the WBN FSAR in corresponding sections.

As outlined earlier in Section 4.4.1 of this report, backflow of potentially radioactive drainage into floor drains is unlikely and venting of dissolved radioactive gases presents an insignificant exposure issue.

4.7.8 Summary

On the basis of the foregoing, the evaluation team found that, although System 43 contained radioactive material in the pipe chase piping, such presence was known and was part of the system's design intent. Sufficient valves are present for isolation of System 43 equipment and piping and for controlled draining of System 43 effluent under routine and emergency conditions. Precautions have been taken in the design and location of System 43 equipment and piping to maintain personnel exposure levels to radioactivity within 10 CFR 20 limits. The concern is accurately stated but is not a valid problem.

4.8 Tank Level Switches - Element 229.8

4.8.1 Overview

Concern IN-85-772-006 was initially raised on 08/22/85 at WBN and addresses the demineralized water makeup to the chilled water loops supporting several air-conditioning systems. The concern centers on the adequacy of the makeup methods for the chilled water systems at WBN. Because of similar techniques employed at SQN, the concern was considered generic to SQN.

The concern does not contend that the present methods are unworkable or unsafe. Therefore, while the concern includes chilled water loops that are safety-related, the issue does not present a safety-related problem.

The issue was previously investigated at WBN without resolution (Refs. 122 and 123), and subsequently resulted in PIR WBN EEB8671 being issued (Ref. 124).

4.8.2 System Description

The air-conditioning systems in question each employ a closed chilled water loop to convey heat from air handling units to refrigeration chillers. A compression tank, also referred to as an expansion tank, is connected to the chilled water pump suction. The purpose of this tank is to accommodate the loop swell and shrinkage resulting from temperature variations and to ensure positive pump suction. The tank is not intended for inventory storage. A low level switch installed below the tank senses the need for makeup and energizes a solenoid-operated valve allowing the admission of demineralized water to the system under regulated pressure conditions. As the level rises, the switch resets and demineralized water admission is cut off. The system is designed for automatic operation without manual control for operator override (Ref. 249).

At WBN, there is an open expansion tank for the incore instrument room cooling system that is designed to contain makeup water. Inventory is lost by evaporation. The level switch installed at the tank alarms in the control room when the level drops below the required operating setpoint. Makeup and tank filling are accomplished manually. This system is not equipped for automatic makeup (Ref. 250).

4.8.3 Analysis

The operative portion of the concern states that:

> "Operations has to work the switch manually to fill the tank. This is inefficient. One switch is needed for high water level, and one for low water level."

The documents reviewed (Ref. 251) and the physical walkdowns confirmed that the compression tanks have Mercoid Model 203G-7810 float-type level switches with single pole double throw (SPDT) snap action contacts for low-level actuation of automatic makeup. When the level rises past the switch reset point, the solenoid-operated water admission valve closes. This means that only enough inventory is admitted to overcome the level switch set/reset hysteresis. The type of level switch used for this application has a narrow operating band, allowing a 1-1/4-inch differential between the set and reset levels.

Apparently the CI wants to widen the hysteresis band using a low-level switch to energize the admission valve and a high-level switch to turn it off. If the compression tanks were open, such an arrangement would probably work. In closed tanks, however, the possibility exists that the system could become over-pressurized.

If the tanks were filled to a level higher than switch reset level during low temperature conditions, there may not be sufficient expansion volume to accommodate swell as temperatures rise. This could result in excessive system operating pressures. Although the relief valves on the tank prevent unsafe pressurization, it is not good practice to depend on relief valves for safe operation.

Since the purpose of the tanks is not inventory storage but accommodation of loop swell and shrinkage resulting from temperature variations, large quantities of demineralized water are not required for system makeup.

The purpose of the level switch is not to fill the tank but to ensure the availability of makeup water during normal chilled water system operation. When the system trips owing to a malfunction, or is not in service, the admission valve will automatically close regardless of the tank level.

WBN differs from SQN slightly in that it has an open expansion tank for the incore instrument room cooling that is neither designed nor intended for automatic filling and makeup. The level switch in this case is installed above the bottom of the tank. It provides control room annunciation on a low level, to indicate that makeup is required. If the level continues to drop, the level switch will cause the chilled water pump to trip. System makeup is provided by manually opening the demineralized water inlet valve. The addition of a high-level switch in this system would be of no benefit because the system is not designed, equipped, or intended for automatic makeup operation.

PIR WBN EEB8671 resulted from a prior investigation and addressed the systems having closed compression tanks. This PIR contended that "level switches have been mislocated below the tanks." It further stated:

> "This disables the chilled water systems ability to maintain pressure and water makeup", and in closing: "This condition does not disable operation of the systems, since system pressure and water inventory are maintained by the circulating pumps and makeup water."

Because the PIR Description of Operation was self-contradictory and the purpose of the closed compression tanks was actually as described above, no further evaluation of the PIR was made.

4.8.4 Summary

On the basis of the foregoing, the evaluation team found that the WBN and SQN chilled water systems employing closed compression tanks are designed and instrumented for automatic makeup. This system design has experienced no operational or maintenance difficulties at SQN (Ref. 252). The design change suggested for these systems is technically unsound, and, therefore, the concern is not valid for these systems at either facility.

The WBN chilled water systems employing open expansion tanks are designed and intended for manual makeup. The addition of a high-level switch as suggested in the concern would not, in and of itself, allow automatic makeup of the tank because these systems are not equipped with valves for automatic operation. The concern is correctly expressed for WBN but is not a valid technical issue requiring any changes.

4.9 <u>Acoustics Monitoring - Element 229.9</u>

4.9.1 Overview

This concern relates solely to WBN. It addresses the lack of redundancy in the loose parts monitoring system (LPMS) and does not present a generic safety issue, as the LPMS is not a safety system.

4.9.2 LPMS Description

The design purpose of the LPMS is to prevent fuel damage from impact by loose parts in the primary system. The system provides continuous monitoring to detect such objects. When the monitoring system detects a loose part, the "data recorder" mentioned in the employee concern (EC) is actuated, an alarm is actuated, and the recorder begins registering the acoustic response. The recorded information is then used as a diagnostic aid in determining the nature of the loose part (Ref. 253).

4.9.3 Analyses

The LPMS is not a safety-related system. The six sensors in the reactor coolant system are redundant. The alarm system and the data acquisition system, including the data recorder, are not redundant. This is in accordance with Regulatory Guide 1.133 (Ref. 125). The safety evaluation report (SER) and SER Supplement 3 (Ref. 126) state NRC acceptance of the design of the WBNP LPMS.

The EC may relate to a lack of redundancy only as regards the recorder. If the data recorder is not operational, the sensors will still alarm in the control room to initiate operator actions. Thus, the acoustic monitoring function would still be operational, contrary to the statement in the concern. However, as the TVA response to request investigation (Ref. 127) pointed out, ". . . a spare recorder for the LPMS was purchased on contract 83P69-332998. This recorder is presently in stock in power stores under TIIC number BAP-042E. Therefore, there is a backup data recorder." WBN Technical Specification 3.3.3.11 and Regulatory Guide 1.133 provide 30-day limitations on LPMS sensor unavailability, but do not address data recorder unavailability.

4.9.4 Summary

On these bases, the evaluation team concluded that the issue of redundancy for the LPMS data recorder was not a valid concern. In the process of the review, however, the evaluation team noted that Regulatory Guide 1.133 requires an LPMS description in FSAR Section 4.4.5, "Instrumentation Application." The WBN FSAR includes partial information in Section 7.6.7 and other unreferenced information in the responses to NRC questions 221.10, 221.13, and 221.16, but nothing in Section 4.4.5. In addition, a required reference to the technical specifications is missing.

The WBN FSAR should be updated to incorporate the information contained in the responses to NRC Questions 221.10, 221.13, and 221.16, and a reference to the LPMS technical specifications.

4.10 <u>Mercury Switches - Element 229.10</u>

4.10.1 Overview

Concern BNP-QCP-10.35-18, which addresses an ostensible proscription of mercury-containing devices in nuclear power plants, was initially raised 06/23/86 on BLN. Because of its general nature, the concern was subsequently determined to be generically applicable to WBN, SQN, BLN, and BFN. No NSRS investigations were conducted in response to this concern, and no specific corrective actions have taken place as a result of it. Documentation supporting the concern statement that such switches were "taken out at SQN and replaced with other switches" could not be established.

4.10.2 Analysis

The CI is clear about the fact that he is "not concerned with mercury contamination," yet goes on to express the opinion that "mercury switches are not supposed to be used on nuclear power plants." This is interesting because "mercury contamination" was established as early as 1968 as the predominant basis for the exclusion of switches and other devices containing mercury from critical areas and systems (Ref. 128). This exclusion was formalized as TVA design guidance in 1983 with the publication of TVA Mechanical Design Standard DS-M18.1.2 (Ref. 129).

Not only does mercury adversely interact with other metals used in nuclear power plants (stainless steel, aluminum, copper containing alloys, Inconel, etc.), it is toxic and should be excluded from closed spaces (e.g., nuclear submarines) in which personnel must work. These exclusions are so well understood and implemented (Ref. 129) that the concern seems to be addressing the use of "mercury switches" from a specific engineering applications standpoint.

Mercury is the only electrically conductive metal that exists in liquid form at standard temperature and pressure. In switch applications, its tendency to provide a clean contact surface on each change of state gives it a clear advantage over "dry" type contacts that are prone to pitting and corrosion. Mercury type switches are essentially maintenance-free and are frequently used extensively where accessibility or other maintenance-hampering problems are encountered.

Proper application of mercury switches, however, must also consider some of its disadvantages, one of which is spurious actuation by vibration. When mercury contacts are made in "tilt bottle" applications (i.e., where the mercury is contained in a glass bottle and makes contact between two fixed electrodes as the bottle is physically "tilted" to position by an outside force), the tendency of the meniscus to break and the ease with which the metal will flow makes the point of transfer (i.e., contact change of state) somewhat unpredictable under vibratory conditions. As the bottle approaches the transfer point, the sensitivity to premature or erroneous transfer from induced vibratory motion increases. For these reasons, the use of mercury switches is best restricted to slow-moving processes where vibration-free mounting is possible and the switch transfer point is not critical (e.g., large tank or sump level monitoring). Where the process has inherent pulsating or vibratory motion (e.g., air compressors, diesel engines, etc.) or the transfer point is critical, especially with a narrow set-reset range, such applications are ill-advised.

As a point of clarification, it should be noted that the above discussion does not apply to mercury wetted contacts whose transfer point is established by positive means (i.e., manual transfer, electromagnetic coil, etc.) not sensitive to vibration. Also, the amount of mercury in most mercury wetted contacts is small and in a contained state so that the contamination potential is nil. For these reasons, TVA Mechanical Design Standard DS-M18.1.2 exempts instruments with "mercury wetted contacts" from the restrictions imposed on the use of mercury in TVA projects.

4.10.3 Regulatory Guidance

The general application of 10 CFR 50 Appendix A, General Design Criterion 2, stipulates that "components important to safety" must not lose their ability to "perform their safety functions" when subjected to "natural phenomena," including earthquakes. The possibility of a spurious transfer initiating an action adverse to safety during a seismic event has generally caused nuclear power designers to avoid using mercury switches in safety-related applications for diesel generators. While absolute prohibition may be unnecessary, these limitations, coupled with mercury's contamination potential, have generally discouraged their use.

The application limitations outlined above, as well as the ever-present contamination potential, often incur design control programs whose implementation burden may outweigh the advantages of mercury-containing switches. In such instances, it may be more effective to exclude the use of mercury entirely. This approach was suggested as early as 1971 (Ref. 130) during the design phase of SQN. Up to 1983, the time that official design guidance (Ref. 129) was issued on the subject, this approach was apparently so well understood (Refs. 130 and 131) that the general presumption expressed in the concern (i.e., "Thinks mercury switches are not supposed to be used in nuclear plants") obtained general acceptance as design guidance in the absence of any documented practice. However, a universally applied and documented prohibition, as such, against the use of mercury switches in the nuclear power industry does not exist. In 1980, an NRC IE Bulletin (Ref. 132) was issued on a specific make and model mercury wetted relay, but the issue malfunction was not related to the use of mercury.

4.10.4 Assessment of Mercury Usage at TVA

From the foregoing analysis and review of regulatory guidance, it is clear that the use of mercury is not specifically prohibited but is subject to severe limitations. The evaluation team, therefore, turned its attention to determining if these limitations were actually addressed at TVA.

The evaluation team first identified the instrumentation on systems in the respective Diesel Generator Buildings and then physically inspected them to ensure either that they did not use mercury or did so in accordance with TVA Design Standard DS-M18.1.2.

A review of systems drawings and instrument tabulations at each plant (Refs. 133 through 153) showed the following diesel generator support systems to have instruments potentially containing mercury:

- Fuel oil system
- High-pressure fire protection system
- CO_2 storage, fire protection, and purge systems
- Diesel starting air system
- Lube oil system
- Emergency equipment cooling water (BFN only)
- Standby diesel generator and controls (BLN only)

The instrument tabulations (Refs. 141, 143, 151, and 153) for each plant identified the instruments located on these systems. Physical walkdowns of the respective Diesel Generator Buildings, augmented by a review of vendor drawings (Ref. 154) and calibration records, established the manufacturer and model number of each instrument. (In cases where instruments were inaccessible, nameplate identification was not possible, so vendor prints were used to identify make and model.)

With make and model known, commercial literature was used to establish the presence or absence of mercury. Data resulting from these reviews/walkdowns and literature research were compiled in tabular form and are presented in Tables 26, 27, 28, and 29, Attachment D, for SQN, WBN, BFN, and BLN, respectively.

4.10.5 Summary of Results

No mercury-containing switches were found at SQN, WBN, or BLN. Data supporting this fact are tabulated in Tables 26, 27, and 29. At WBN, limit switches containing free mercury were found to be installed in the General Electric supplied 6.9 kV switchgear of the fifth (i.e., nonsafety) Diesel Generator Building. This unit was added at a later date. These switches, which constitute an exception to the general rule excluding free mercury, were evaluated and approved by TVA letter from F. W. Chandler, Chief Electrical Engineering Branch, to B. B. Sams, General Electric Co., 01/29/74 (Ref. 260).

BFN was found to contain switches using mercury contacts. The BFN data are attached in Table 28. The acceptability of this exception to the general rule is currently being assessed. Thus, the concern is valid for BFN but not for the other TVA nuclear plants.

On the basis of the foregoing, the evaluation team concluded that the present instrumentation installed in the SQN, WBN, BLN, and BFN Diesel Generator Buildings is in agreement with TVA Design Standard DS-M18.1.2, which appropriately restricts the use of switches containing free mercury.

The contamination potential and the limitations of mercury switches in instrumentation applications are well established. By custom and precedent, this has led to very restrictive use of such devices in nuclear power plants. Present TVA design guidance now clearly documents these restrictions, but common engineering practice has precluded their use before such guidance was documented. The absence of mercury switches in the SQN Diesel Generator Building has been confirmed by physical walkdown. The concern is not valid for SQN.

Except as noted for the fifth Diesel Generator Building at WBN and the limited existence of mercury switches in the Diesel Generator Buildings at BFN, mercury switches are not used.

The concern was, therefore, generally not valid, subject to a confirming assessment to be conducted on the limited use at BFN.

4.11 Radiation Monitoring - Element 229.11

4.11.1 Overview

Concern IN-85-144-001 was raised initially at WBN, and although it contained many specifics, it expressed a general reservation as to the adequacy of the present WBN radiation monitoring system (RMS). The issue was later interpreted to be broad enough to apply to all TVA nuclear plant sites.

The CI used the term "enough" in the context of "not . . . enough radiation detection equipment in the plant." This, when combined with the later phrase, "needs more radiation monitoring equipment," demonstrated an explicit concern as to quantity. At no point did the concern directly express qualitative reservations about the equipment in place. Therefore, the evaluation team could have assumed that parameters relating to the quality of the equipment in question (i.e., sensitivity, range, response time, seismic hardness, environmental qualification, etc.) were not issues. Nevertheless, to achieve as complete a verification as possible, and to preclude speciously narrow interpretations, certain key qualitative parameters also were addressed.

The concern was interpreted as being applicable to the complete Process and Effluent Radiological Monitoring and Sampling System (PERMSS). This "system" is actually a grouping of sampling/monitoring subsystems located at each release point and on selected processes that have a potential for carrying radioactive inventory. The CI also clearly refers to a putative inability of the present RMS "to meet federal guidelines." This contention presented a licensing compliance issue both as to the original RMS adequacy and to its compliance with the newer (i.e., post-TMI) federal requirements.

The use of the term "radiation detection equipment" suggested that the concern may also relate to the area radiation monitoring system (ARMS). The PERMSS and the ARMS combined constitute the radiation monitoring system (RMS) whose overall purpose, as defined by the relevant regulatory criteria and guidance, is to monitor various process streams (gas, steam, or water) and plant areas to give early warning of degraded conditions that might present health hazards to plant operators or to the public (Refs. 155 through 162).

4.11.2 Evaluation Approach

Using the above interpretations, the evaluation team reviewed the entire RMS at each site. For the PWR plants (SQN, WBN, and BLN), two different approaches were used: first, a general comparison with radiation monitoring practices at other PWRs, and, second, a verification review of the design criteria, design drawings, and FSAR against the SER findings.

While each plant was reviewed separately, the following grouping of results is based on reactor type. The three PWRs (SQN, WBN, and BLN) share many common characteristics and so are grouped together, with some unique differences pointed out. The only BWR, BFN, is treated separately to avoid confusion.

For each facility, the approach took the same general path. First, a description of the RMS in each unit was stated. These descriptions were then compared with the federal guidelines to assess general compliance. A specific compliance with more recent (e.g., post-TMI) changes was also ascertained. Confirmatory assessments of adequacy were drawn by comparison with similar RMS at other non-TVA facilities. A review of the NRC's approach and its SER assessment for each unit verified the NRC's general concurrence with the evaluation team's independent conclusions. In addition, specific assessments of key RMS variables were performed to verify general qualitative parameters of the RMS at each plant.

In addition, as a result of the "Lessons Learned at Three Mile Island," (Ref. 175) the NRC requires that certain radiological monitoring information be provided to help follow the course of an accident. These postaccident radiation monitoring requirements, as delineated in Regulatory Guide 1.97, mostly make use of existing instrumentation qualification requirements. Installation of new hardware to replace previously installed instruments also may be necessary. In some instances, additional radiation monitors are required. Where this was the case, these additional monitors were included with the RMS for evaluation of the subject concern.

The station vent stack RMS for each plant was reviewed as a discrete issue, as it was specifically mentioned in the concern. A general assessment of each unit's area RMS was also included for completeness.

Federal Guidelines

The suggestion in the concern that there is not "enough radiation detection equipment . . . to meet federal guidelines" presents a basic license compliance issue. To assess this, the evaluators first had to establish what the federal guidelines were. This necessitated review of References 155 through 164 and 174 through 179, resulting in the following general summary.

The operational limits placed on release of radioactive materials are established by 10 CFR 20 (Ref. 160). This is to be contrasted with Section 50.34a of 10 CFR 50 (Ref. 155), which establishes the general design guidance to be used to "maintain control over radioactive materials in gaseous and liquid effluents" and to keep "levels of radioactive materials in effluents to unrestricted areas as low as reasonably achievable." Appendix A of 10 CFR 50 sets out three general design criteria in this regard (Refs. 156, 157, and 158):

> "Criterion 60 - Control of releases of radioactive materials to the environment. The nuclear power unit design shall include means to control suitably the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences. Sufficient holdup capacity shall be provided for retention of gaseous and liquid effluents containing radioactive materials, particularly where unfavorable site environmental conditions can be expected to impose unusual operational limitations upon the release of such effluents to the environment."

> "Criterion 63 - Monitoring fuel and waste storage. Appropriate systems shall be provided in fuel storage and radioactive waste systems and associated handling areas (1) to detect conditions that may result in loss of residual heat removal capability and excessive radiation levels and (2) to initiate appropriate safety actions."

> "Criterion 64 - Monitoring radioactivity releases. Means shall be provided for monitoring the reactor containment atmosphere, spaces containing components for recirculation of loss-of-coolant accident fluids, effluent discharge paths, and the plant environs for radioactivity that may be released from normal operations, including anticipated operational occurrence, and from postulated accidents."

Appendix I of 10 CFR 50 (Ref. 159) establishes numerical guidelines for the term "as low as reasonably achievable" (ALARA). Generally, the Appendix I guideline limits are estimated annual doses of 3 millirems (total body) or 10 millirems (any organ) for liquid effluents, an estimated annual air dose of 10 millirads (gamma), 20 millirads (beta), or gaseous effluent estimated annual external dose of 5 millirems (total body). Because of their cnemical tendencies to concentrate in the thyroid, the iodine isotopes are singled out and limited to a 15 millirem limit exposure to any organ. This applies to particulate isotopes as well. The concluding statement of the Annex to Appendix I establishes a 5 millirem total body or any organ dose limit on liquids released from multiunit sites or a total quantity of 5 curies/year per reactor (excepting tritium and dissolved gases). For gaseous effluents from multiunit sites, the 10 millirad (gamma), 20 millirad (beta), and 15 millirem (iodines and particulates) dose limits of Appendix I are confirmed by the Annex. Appendix I also establishes cost-benefit guidelines for containing and processing radioactive inventories at $1,000 per man rem, total body and thyroid.

Of the relevant regulatory guides, Reg. Guide 1.21 (Ref. 161) most directly addresses implementation of the 10 CFR 20 operating release limits. Reg. Guide 1.21 requires monitoring of all "significant paths for release of radioactive material" to demonstrate compliance. It also stipulates requirements to evaluate "performance of containment, waste treatment and effluent controls" and collection of data to "permit evaluation of environmental impact and potential dose to the public." The most significant RMS parameters set by Reg. Guide 1.21 are the required sensitivities. For gases this is generally set at a minimum detectable concentration of 10^{-4} uCi/cc for being equivalent to the 10 millirad (gamma) and 20 millirad (beta) limits of Appendix I. Iodine and particulate measurements are set at the 15 millirem organ (thyroid) levels. Tritium is treated as a special case of gas with a minimum detectable concentration of 10^{-6} uCi/cc. Gross activities of 10^{-7} uCi/cc in liquids should be detectable with higher concentration limits set for individually identified gamma emitting isotopes (5×10^{-7} uCi/cc) and special case limits set for Sr-89 and Sr-90 (5×10^{-8} uCi/cc).

Both NUREG-0737, Supplement 1 and Regulatory Guide 1.97 (Rev. 2) resulted from lessons learned at Three Mile Island and use the radiation monitoring system primarily to assess containment radiation levels, release control, and systems operations following an accident. These postaccident monitoring (PAM) requirements mostly made use of instrumentation already in the plants, but, in many cases, added requirements (e.g., seismic and environmental qualification) necessitated new procurement at many facilities.

4.11.3 SQN, WBN, and BLN Descriptions

All PWRs have essentially the same basic sources of radioactivity in their process piping. Generally, any system that communicates with the reactor coolant system (RCS) or "primary loop" is presumed to carry radioactive inventory. This is the case whether the communication is by direct piping connection or through heat exchanges and steam generators where leakage is presumed.

In addition, those processes that treat liquid waste collected from various points throughout the plant are also presumed to carry radioactive inventory. All such processes are either sampled or monitored, sometimes both, to ensure that they meet federal design criteria (Refs. 156, 157, and 158), operational standards (Refs. 159 and 160), and regulatory guidelines (Refs. 161 through 164).

SQN RMS Description

At SQN, which is generally representative of the processes at WBN and BLN, the following processes were considered to have a reasonable potential for carrying radioactive material in sufficient concentrations to warrant radiation monitoring:

- Reactor Coolant
- Chemical and Volume Control (Boron Recirculation)
- Residual Heat Removal
- Steam Generator Blowdown
- Condenser Vacuum Pump Exhaust
- Essential Raw Cooling Water
- Component Cooling
- Fuel Pool
- Containment Building Drain Sump
- Station Sump Discharge
- Waste Disposal System Liquid

Since radioactive vapors can escape from the above processes, certain sections of the plant's ventilation system must be monitored to detect releases. These monitors will vary from plant to plant depending on plant arrangement, ventilation system design, and number of release points. At SQN, once again a general indicator of parallel processes for WBN and BLN, the following ventilation systems are monitored to control the release of airborne radioactivity:

- Shield Building Vent
- Auxiliary Building Vent
- Service Building Vent
- Containment Building Compartments (two levels)
- Containment Building Purge Air
- Containment Building Personnel Hatch
- Post-Accident Sample Room

In addition to monitors whose basic purpose is release control, there are certain unique purpose monitors designed for unusual occurrences and accidents. At SQN these monitors are:

- Main Control Room Air Monitors
- Main Control Room Air Intake Monitors

As will be demonstrated later, monitoring of the above systems is directly consistent with the RMS practices at other licensed and operating PWRs.

The SQN PERMSS is generally described in FSAR Section 11.4 with particular attention to important parameters (sensitivity/range, detector type, background level, etc.) listed in FSAR Tables 11.4.2-1 (Liquid) and 11.4.2-2 (Gaseous). Data from this document were extracted and recompiled for this evaluation. These data are presented in Table 30, attached. Table 31 lists SQN monitors that are in addition to those listed for both WBN and SQN plants in Table 30, Attachment D.

It should be noted that the SQN FSAR description is, in many cases (e.g., Refs. 178 and 179 for SQN), out of date with respect to the particular plant's design criteria (Ref. 166) and the design drawings (Refs. 167 through 172). Therefore, reading the FSAR by itself could lead to a conclusion that "there is not enough radiation detection equipment" to meet current "federal guidelines." The FSAR should be updated.

WBN RMS Description

Information extracted from the WBN FSAR Sections 11.4, 12.3.4 and 7.5 (Ref. 192), including a brief summary of the WBN RMS, is provided in Table 30, Attachment D. This information includes the system, area, or stream monitored and the number and type of detectors installed. The RMS monitors are grouped as liquid effluent monitors and gaseous effluent monitors, which constitute the PERMSS, and area radiation monitors and airborne particulate monitors, which constitute the ARMS. A number of the monitors shown in Table 30 provide the necessary radiation monitoring functions during and following an accident in accordance with the PAM guidelines of Regulatory Guide 1.97.

The evaluation team used the SQN and WBN FSARs and the revised TVA design criteria for the SQN and WBN RMSs (Refs. 166 and 194) to examine the similarities and differences between the WBN RMS and the SQN RMS. Table 31, Attachment D, lists SQN monitors that do not appear in the WBN design, along with a basis for the difference.

WBN has three monitor groups in addition to those provided for SQN, namely, the single liquid effluent monitor for the condensate demineralizer regenerate, the eight main steamline radiation monitors which are provided for WBN to satisfy the guidelines of Regulatory Guide 1.97, and the airborne particulate monitors in the Auxiliary and Containment Buildings noted on the last page of Table 30. However, SQN has four groups of monitors, as established by SQN-DC-V-9.0, R2, that are not listed for WBN. The need for these SQN monitors was established in May 1979 by a special task force. This task force was appointed to make recommendations relating to TVA's nuclear program in view of the TMI accident. Since these early recommendations were formulated, many additional and more comprehensive studies have been completed which have led to expanded and improved requirements for radiation monitoring systems (Refs. 177, 185, and 200). Implementing these new requirements has eliminated a regulatory need for the specific monitor groups identified. Thus, these monitors are not required for WBN licensing purposes.

As a final step in examining the differences between WBN and SQN, the as-built drawings (Refs. 198 and 170) and the instrument lists (Refs. 199 and 184) for the two plants were compared. The comparison showed that the previously noted differences between the two plants exist only on paper. The comparison also showed that the actual installed monitoring equipment for the two plants is nearly identical. The only significant difference in the RMS between the plants is that eight main steamline radiation monitors, which satisfy the requirements of Regulatory Guide 1.97, have been installed at WBN but not at SQN.

BLN RMS Description

The BLN RMS monitors are grouped as effluent or process monitors, which constitute the PERMSS, and area radiation monitors/airborne particulate monitors, which constitute the ARMS. Table 32, Attachment D, lists the individual monitors composing the BLN RMS. However, the BLN FSAR through amendment 27 (Ref. 218) provides an incomplete description of the BLN RMS. In addition, it is not consistent with the design drawing 2GW0900-IR-7, R12 (Ref. 219). This will be addressed in detail later in this report. A number of the monitors shown in Table 32 provide the necessary radiation monitoring functions during and following an accident in accordance with the PAM guidelines of Regulatory Guide 1.97.

4.11.4 SQN, WBN, and BLN RMS Equivalence to Other PWRs

An independent verification of the adequacy of each plant's PERMSS was performed by comparing the SQN, WBN, and BLN systems monitored with equivalent systems for a standardized PWR plant (the Standardized Nuclear Unit Power Plant System or SNUPPS), a remote dry site PWR (Palo Verde), and a shoreline PWR unit close to a metropolitan area (San Onofre). The data used for this comparison are outlined in the FSARs for each of these plants (Refs. 239, 254, and 255).

The quantity of detection equipment and its location within each plant depends greatly upon the operating procedures, plant arrangement, health physics program, and process design. A comparison of the data for these plants shows that TVA monitors essentially the same systems as those listed above and as outlined in Tables 30, 31, and 32, and that they have monitors at all release points, as well as an equivalent number of special purpose monitors. Variations in individual plant design prevent direct line-by-line correlation. However, an objective professional judgment of equivalence is easily drawn by the commonality of the basic processes monitored.

While the number of release paths at each plant establishes the quantity of monitors required, the release limits are established by federal standards common to all plants. Therefore, to ensure compliance with these standards, the most key equipment parameter (i.e., sensitivity to trace isotopes setting the predominant nucleonic nature of the release effluent) were compared. RMS sensitivity is established by the physical and chemical collection efficiency of the sampling medium and by the detector's ability to sense the radiation of the trace nuclides in question above a certain background. The clearest statement of sensitivity is in terms of the systems minimum detectable concentration to a specific isotope. Usually the isotopes identified are those that are the most abundant and, thereby, set the nuclear characteristics of the gross mixture. (Isotopes rarely occur individually.) These are called the "trace isotopes." Often, because of their biological significance, certain isotopes are sampled or monitored individually even though they don't constitute a predominant part of the gross mixture. These factors are common to SQN and the other plants reviewed. The following table compares SQN, WBN, and BLN sensitivities to such traces with similar PWR units.

General Comparison to Other PWR PERMSS

Parameter	WBN/SQN/BLN	Palo Verde	San Onofre	SNUPPS
Gas				
Trace Isotope	Kr-85	Kr-85	Xe-133	Xe-133
Sensitivity *	10^{-6}	10^{-6}	10^{-7}	10^{-7}
Particulate				
Trace Isotope	Cs-137	Cs-137	Cs-137	Cs-137
Sensitivity *	10^{-9}	10^{-9}	10^{-12}	10^{-12}
Halogen Monitors				
Trace Isotope	I-131	Ba-133	I-131	I-131
Sensitivity *	10^{-9}	10^{-9}	10^{-11}	10^{-11}
Process Liquids Monitors				
Trace Isotope	I-131	Cs-137	Cs-137	Cs-137
Sensitivity *	10^{-6}	10^{-6}	10^{-7}	10^{-7}

* All sensitivities are given in terms of uCi/cc concentrations of the trace isotopes in question.

The sensitivity differences above do not necessarily mean that TVA's PERMSS are less sensitive than those at San Onofre or SNUPPS. To understand why requires some explanation about how sensitivity statements are derived and specified.

Sensitivity of RMS equipment is usually specified in terms of a signal-to-noise ratio. The signal is produced by sensing the disintegration rate of the sampled isotope(s), and the noise is generated by naturally occurring radiation sources (i.e., cosmic, radon-thoron gases, etc.), radiation fields in the plant, and electronic noise (i.e., thermionic photo-cathode emissions, electromagnetic interference, micro-phonics, etc.)

For a signal to be "readable," it must rise above the noise level by a certain factor. Sometimes this is specified as "net signal equal to background [noise]" where a 100 count per minute (CPM) background would require a sufficient concentration of the sampled isotope to generate a 100 CPM signal. Therefore, if the background noise level rises, the signal necessary to overcome it rises as well, and a higher isotopic concentration is necessary making for a less sensitive monitor.

It can be seen, therefore, that a monitor having a sensitivity of, say, 10^{-7} uCi/cc in a 0.1 mR/hr background would only have a 10^{-6} uCi/cc sensitivity if the background were 1.0 mR/hr. The "natural" background is usually established at 0.1 mR/hr, and many plants (e.g., San Onofre) attempt to locate their monitors in environments where the plant induced background can be disregarded. Other plants (e.g., Palo Verde, SQN) want to have more latitude in the final location of the monitor and so they will assume a plant induced background of 1.0 mR/hr. and accept a lower sensitivity statement even though the monitors may be identical.

Another variable in background noise may be the amount of margin the designer wants in avoiding spurious alarms triggered by environmental conditions. In monitors using photo-multiplier tubes (i.e., scintillation detectors), the background noise due to thermionic emission from photo cathodes can rise exponentially with linear changes in temperature. Therefore, if temperature variations are to be expected, the designer may choose to establish set point or sensitivity at signal levels where this is not a factor. This too would call for a lower sensitivity statement even though the monitors were identical.

The manner in which the signal-to-noise ratio is specified also affects sensitivity. The "net signal equal to background" statement noted earlier is very conservative. Less conservative approaches are where the standard statistical deviation of the background is multiplied by a certain factor to achieve a statistical confidence level. For example, the factor 2 would provide the "95% Statistical Confidence Level (SCL)."

Using this method, if one monitor had a 100 CPM background on a 1-minute sampling base, the standard deviation would be about 10 CPM and the "95% SCL" about 20 CPM. The isotopic concentration necessary to produce this is only 20 per cent of the concentration necessary to produce a "net signal equal to background." Thus the "95%" SCL monitor would appear to be five times as sensitive even though the equipment was identical.

Other factors such as sampling and response times can affect sensitivity statements. For example, the same fixed filter particulate monitor could have a sensitivity of 10^{-10} uCi/cc if it sampled a long lived isotope for 12 minutes, but could be said to have a sensitivity of 10^{-11} uCi/cc if it sampled for 2 hours.

For these and several more technical reasons (e.g., secular equilibrium where decay times approach sampling times), the very same monitors can have sensitivity statements that differ by a decade or more.

With these considerations in mind, the evaluation team found that the SQN, WBN, and BLN monitors seem directly consistent with those at Palo Verde and acceptably close to those at San Onofre and SNUPPS to be considered equivalent.

4.11.5 NRC Evaluations of SQN, WBN, and BLN

Salient portions of the NRC's Safety Evaluation Reports on each plant's radiation monitoring system were independently assessed against the regulatory guidance outlined earlier.

SQN Safety Evaluation Report (SER) (Ref. 173)

SQN SER Section 11.0 established that the following design parameters were applied by the NRC in assessing the SQN PERMSS:

- "In our evaluation of the process and effluent radiological monitoring and sampling systems, we have considered the system's capability: (1) to monitor all normal and potential pathways for release of radioactive materials to the environment, (2) to control the release of radioactive materials to the environment, and (3) to monitor performance of process equipment and detect radioactive material leakage between systems."

These design parameters were compared with the federal guidelines outlined above and found to be consistent with 10 CFR 20, 10 CFR 50, and Regulatory Guide 1.21. With its analysis guided as outlined above, the NRC concluded that:

> "Based on the following evaluation, we conclude that the liquid and gaseous radioactive waste treatment systems for Sequoyah Nuclear Plant are capable of maintaining releases of radioactive materials in liquid and gaseous effluents to 'as low as is reasonably achievable' levels in accordance with 10 CFR Part 50.34a, and with Section II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50."

> "Based on our evaluation, as described below, we find the proposed liquid, gaseous and solid radioactive waste systems and associated process and effluent radiological monitoring and sampling systems to be acceptable."

Referring more specifically to monitoring and sampling equipment locations and types, the NRC stated in Section 11.2 of the SQN SER:

"We have reviewed the locations and types of effluent and process monitoring provided. Based on the plant design and on continuous monitoring locations and intermittent sampling locations, we have concluded that all normal and potential release pathways are monitored. We have also determined that the sampling and monitoring provisions are adequate for detecting radioactive material leakage to normally uncontaminated systems and for monitoring plant processes which could affect radioactivity releases. On this basis, we consider the monitoring and sampling provisions to meet the requirements of General Design Criteria 60, 63 and 64 and guidelines of Regulatory Guide 1.21, 'Measuring, Evaluating, and Reporting Radioactivity Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants'."

The ability to monitor and sample, as outlined above, was carried further into the PERMSS ability to automatically terminate disallowed releases. The following conclusion was reached in Section 11.3 of the SQN SER:

"Our review of the radiological process and effluent monitoring system included provisions for sampling and monitoring all normal and potential effluent discharge paths in conformance with General Design Criterion 64, for providing automatic termination of effluent releases and assuring control over releases of radioactive materials in effluents in conformance with General Design Criterion 60 and Regulatory Guide 1.21, for sampling and monitoring plant waste process streams for process control in conformance with General Design Criterion 63, for conducting sampling and analytical programs in conformance with the guidelines in Regulatory Guide 1.21, and for monitoring process and effluent streams during postulated accidents. The review included piping and instrument diagrams and process flow diagrams for the liquid, gaseous, and solid radwaste systems and ventilation systems, and the location of monitoring points relative to effluent release points. We conclude that the applicant's radiological process and effluent monitoring systems are acceptable."

WBN Safety Evaluation Report

WBN SER Section 11.1 (Refs. 193 and 201) establishes that the following design considerations were applied by the NRC in assessing the WBN PERMSS:

"In the evaluation of the process and effluent radiological monitoring and sampling systems, the staff has considered the system's capability: (1) to monitor all normal and potential pathways for release of radioactive materials to the environment, (2) to control the release of radioactive materials to the environment, and (3) to monitor performance of process equipment and detect radioactive material leakage between systems."

The design was compared with federal guidelines and found to be consistent with 10 CFR 20, 10 CFR 50, and Regulatory Guide 1.21. With the NRC evaluation guided as outlined above, the NRC states in Section 11.5:

"The staff has reviewed the locations and types of effluent and process monitoring provided. Based on the plant design and on continuous monitoring locations and intermittent sampling locations, the staff has concluded that all normal and potential release pathways are monitored. The staff has also determined that the sampling and monitoring provisions are adequate for detecting radioactive material leakage to normally uncontaminated systems and for monitoring plant processes which could affect radioactivity releases. On this basis the staff considers the monitoring and sampling provisions to meet the requirements of General Design Criteria 60, 63, and 64 and the guidelines of Regulatory Guide 1.21 ("Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Release of Radioactivity in Liquid and Gaseous Effluents from Light Water-Cooled Nuclear Power Plants"), and, therefore, are acceptable."

The ability to monitor and sample, as outlined above, was carried further into the PERMSS ability to automatically terminate disallowed releases. The following conclusion was reached in Section 11.6 of the WBN SER:

"The staff review of the radiological process and effluent monitoring system included the provisions for sampling and monitoring all normal and potential effluent discharge paths in conformance with GDC 64, for providing automatic termination of effluent releases and assuring control over releases of radioactive materials in effluents in conformance with GDC 60 and Regulatory Guide 1.21, for sampling and monitoring plant waste process streams for process control in conformance with GDC 63, for conducting sampling and analytical programs in conformance with the guidelines in Regulatory Guide 1.21, and for monitoring process and effluent streams during postulated accidents. The review included piping and instrument diagrams and process flow diagrams for the liquid and gaseous radwaste systems and ventilation systems, and the location of monitoring points relative to effluent release points. The staff concludes that the applicant's radiological process and effluent monitoring systems are acceptable."

It is interesting to note that in stating this conclusion, the NRC identified in the SER only those portions of the PERMSS indicated in Table 30, Column 3 under "SER." Thus, the NRC did not specifically note in the SER a significant number of important PERMSS monitors incorporated in the WBN design. From this it cannot be concluded, however, that because these monitors were not specifically mentioned they were omitted from consideration in the NRC evaluation. A further observation concerning the NRC evaluation is that the text related to the PERMSS in the WBN SER is, for all practical purposes, identical to that contained in the SQN SER. This similarity even extends to the specific monitors of the PERMSS identified in the two SERs. This is particularly noteworthy since, as can be seen from Table 30, the WBN PERMSS is significantly enhanced over the design described in the SQN FSAR and evaluated by the SQN SER. Although these observations do not demonstrate a lack of thoroughness on the part of the NRC, they do suggest the possibility that the NRC review of the WBN PERMSS was more perfunctory than substantive.

With respect to the postaccident monitoring capability of the PERMSS, the NRC states in SER Section 11.7:

> "NUREG-0737 requires that noble gas monitoring instrumentation and equipment for iodine and particulate sampling, for the detection and measurement of radionuclides in plant effluents be installed by January 1, 1982, or 4 months before an operating license is issued. The applicant has proposed that the installation date be modified so that the required equipment would be in place before fuel loading and has provided interim procedures based on plans developed for Sequoyah. The interim measures are not applicable for the Watts Bar nuclear plant, as indicated in Enclosure 2 of NUREG-0737. Therefore, the staff requires the applicant to provide the information to meet the guidelines of Regulatory Guide 1.97 (Revision 2) and comply with NUREG-0737 4 months before fuel load, so that the staff can complete its review which will be reported in a supplement to the SER."

The RMS provisions proposed by TVA to satisfy these requirements of the NRC have been added to the RMS design (Refs. 194 and 195) and are now included in the FSAR. They are also reflected in Table 30. According to Supplement 4 to the WBN SER, these PAM provisions are still under review by the NRC.

In Section 12.4 of the WBN SER, the NRC describes the results of its evaluation of the WBN ARMS. With respect to this portion of the RMS, the NRC concludes:

> "Detectors for the area radiation monitoring system will be located in normally occupied areas which have the potential for radiation fields in excess of the maximum design radiation dose rate. The detectors are

designed to cover the expected and maximum design dose rates and dose rates as a result of anticipated operational occurrences. The monitors will have readout and annunciation in the control room. They will also have variable alarm set points and local audible alarms. The detectors will be calibrated quarterly. Therefore, the staff concludes that the area radiation monitoring system design is acceptable.

The applicant has provided area radiation monitors around the fuel storage areas to meet the requirements of 10 CFR 70.24 and to be consistent with the guidance of Regulatory Guide 8.12, "Criticality Accident Alarm Systems."

The applicant will rely on the area radiation monitoring system and portable radiation monitoring instruments to assess the radiation hazard to personnel in areas that may be accessed during the course of an accident. The area monitors will receive backup power from the diesel generators. The portable instruments will be placed to be readily accessible to personnel responding to an emergency. The portable instruments will be designed with a sufficient instrument range for use in the event of an accident.

The airborne radioactivity monitoring system is designed (1) to provide a clear indication locally and to operations personnel when abnormal amounts of airborne radioactive material occur and (2) to provide information so that action can be taken to ensure that inhalation of airborne particulates and iodine is within the limits of 10 CFR 20. These airborne radioactivity monitors have the capability to detect 10 maximum-possible-concentration hours (mpc-hr) of particulate and iodine radioactivity in any compartment that has a possibility of containing airborne radioactivity and that may be occupied by personnel. The applicant's portable airborne radioactivity monitoring systems will monitor air in areas not provided with fixed airborne radioactivity monitors. The objectives and location criteria for these monitors are in conformance with 10 CFR 20 and 50 and Regulatory Guides 8.2 and 8.8. The staff concludes that the radiation protection design features for Watts Bar are acceptable with the criteria of SRP Section 12.3 and Items III.D.3.3 of NUREG-0737."

Finally, in Section 12.7 of the WBN SER, the NRC considers the PAM requirements imposed on the ARMS. With respect to the requirement of NUREG-0737 (II.F.1(3)) for a high-range monitor in containment, the NRC concludes:

"By submittals dated October 29 and July 2, 1981, and July 18, 1980, the applicant provided documentation of actions being taken to implement Item II.F.1(3).

"The applicant has committed to install redundant high range radiation monitors in containment, in both the upper and lower containments by fuel loading. The locations are adequate to provide representative postaccident readings. The monitors are General Atomic gamma monitors with a range of 1 to 10^7R/hr and are powered from a vital bus with remote indication and recording in the control room. Sensitivity is adequate to measure all fission product gamma radiation, including XE^{133} energies. Environmental and seismic qualifications will meet the criteria of the Regulatory Guides 1.100 ("Seismic Qualification of 1E Electric Equipment for Nuclear Power Plants"), 1.89 ("Qualification of Class 1E Equipment for Nuclear Power Plants"), and 1.97, Revision 2 ("Instrumentation for Light-Water-Cooled Nuclear Power Plants To Assess Plant and Environs Conditions During and Following an Accident"). Calibration will be performed in accordance with the vendor's methods at each refueling outage. These actions meet the staff positions in NUREG-0737 and are acceptable for fuel loading. The installation of these monitors will be verified by the staff."

With respect to the requirement of NUREG-0737 (III.D.3.3) for inplant radioiodine monitors to accurately measure the radioiodine concentrations in areas within the plant where plant personnel may be present during an accident, the NRC concludes:

"By submittal dated September 14, 1981, the applicant has provided documentation of actions to be taken at Watts Bar to implement Item III.D.3.3 of NUREG-0737.

The Watts Bar Units have portable, low-volume air sampling equipment with both charcoal and silver zeolite filters available for radioiodine sampling. Analyses can be performed in the radiochemical laboratory using a Nuclear Data 6620 system with 3 Ge(Li) detectors.

Backup capability can be provided by an Eberline SAM-2/NaI detection system. Alternate counting facilities, which provide a capability to promptly and accurately analyze samples under low background conditions, are located in the Sequoyah plant training center and the Sequoyah plant radiochemical laboratory. These facilities each have Nuclear Data 6620 systems with 2 Ge(Li) detectors. Procedures and training for postaccident sampling and analysis are provided under the Watts Bar Health Physics Instruction Manual, Radiation Control Instruction Manual, and inplant Training Program.

The postaccident radioiodine sampling and analysis provisions described for the Watts Bar facility satisfactorily meet the staff positions for fuel loading and full-power operations as outlined in NUREG-0737 and are acceptable."

BLN Safety Evaluation Report

The BLN SER was performed by the U.S. Atomic Energy Commission (AEC), and issued on 05/24/74 (Ref. 222). This SER was based on the BLN PSAR as supplemented by amendments 1 through 10.

Because of the age of the BLN SER, it is to be particularly noted that the BLN SER contains neither the TMI-related assessment nor the evaluation of NUREG-0737 implementation by TVA for BLN.

BLN SER Section 11.5 establishes that the following design considerations were applied by the AEC when it assessed the BLN PERMSS:

> "In the evaluation of the process and effluent radiological monitoring and sampling systems, the staff has considered the system's capability: (1) to monitor all normal and potential pathways for release of radioactive materials to the environment in conformance with General Design Criterion 64, (2) to control the release of radioactive materials to the environment in accordance with General Design Criterion 60, (3) to monitor performance of process equipment and detect radioactive material leakage between systems, (4) to automatically terminate the gaseous and liquid waste streams when radioactivity content is above a predetermined level, and (5) compositing of samples for low level analysis and provisions for instrumentation and facilities to perform gross beta-gamma and alpha measurements and isotopic analyses in accordance with Regulatory Guide 1.21 (Measuring and Reporting of Effluents from Nuclear Power Plants, 06/74)."

The design was compared with federal guidelines (Ref. 224) and found to be consistent with 10 CFR 20, 10 CFR 50, and Regulatory Guide 1.21. With the evaluation guided as outlined above, the AEC states in Section 11.5:

> "Based on our evaluation of the radiological process and effluent monitoring system for normal operation and anticipated operational occurrences, we conclude that the plant is adequately provided with process and effluent monitoring equipment and meets the requirements of General Design Criteria 60 and 64. Based on our findings, we conclude that the radiological process and effluent monitoring system is acceptable."

In Section 12.1 of the BLN SER, the AEC describes the results of its evaluation of BLN radiation protection including radiation monitoring and health physics equipment. This review did not specifically address the continuous air monitoring systems and the area radiation monitoring systems. However, the conclusion states:

> "This plant is similar to other licensed light water power reactors in terms of equipment layout, shielding, ventilation and health physics program. Based on past experience from operating nuclear reactor plants, it is estimated that the average collective dose to all onsite personnel will be approximately 450 man-rem per year per unit. Design measures described in the PSAR such as operating valves behind walls prior to maintenance, and shielding of spent filters during removal should minimize the radiation exposure received by plant personnel.
>
> On the basis of the above review, the staff has concluded that the proposed plant design and health physics program provides reasonable assurance that exposure to individuals will be in accordance with the requirements of 10 CFR 20 and are acceptable."

4.11.6 Validation of NRC Safety Evaluations

The evaluation team used three methods to validate the SQN SER findings for each PWR plant. The SQN validation is used as an example of the same effort applied to WBN and BLN.

First, the evaluation team used the current federal guidelines outlined earlier (see Section 4.11.2) and applied them to the FSAR description of the RMS (Refs. 178 and 179 for SQN, Refs. 192 and 193 for WBN, and Ref. 218 for BLN) using the same design parameters that the NRC used in deriving the SER findings quoted above. No discrepancies were found that would lead to conclusions different from the NRC SER conclusions quoted in Section 4.11.5.

Second, to ensure that the NRC SER, which relied mostly on FSAR statements, was supported by the actual design, the evaluation team also compared SER findings and the FSAR statements for each plant with the current PERMSS design drawings (Refs. 167 through 172, 198, 219, and 225), the RMS procurement specifications (Refs. 180 through 183, 194, 198, 220, and 221), and the Mechanical Instrument Tabulations (Refs. 184 and 199), which establish setpoints. This review confirmed that the "as designed" RMS supported the NRC SER findings of compliance with federal guidelines. In the course of these evaluations, it was noted that many design improvements have been made to the PERMSS since the NRC filed its SER on each plant in question. Therefore, the initial NRC finding of adequacy has been enhanced since that time.

The third method used to validate the NRC SER constituted an independent assessment of the current RMS design criteria (Refs. 166 through 172, 180 through 183, 194, 198, 220, and 221) against the federal guidelines outlined above. In this review, discrepancies within the design criteria were noted. For example, Design Criteria SQN-DC-V-9.0 (Ref. 166), paragraph 3.5.2.1, stipulates that the Condenser Vacuum Pump Exhaust Vent Monitor is "to satisfy the requirements of Regulatory Guide 1.45." This is a physical impossibility because Regulatory Guide 1.45 requires detection of the reactor coolant pressure boundary leaks to containment, and a communications path from containment to the condenser does not exist. The discrepancies noted, however, did not result in RMS deficiencies that would conflict with federal guidelines or invalidate the NRC's original findings of adequacy. In fact, the design documentation shows enhancements that would substantiate such findings more today than when originally made.

It should be noted that the NRC SER did not review changes required following the incident at Three Mile Island. This is a different issue and is addressed later in this report. The assessment conducted to this point merely confirms that the present RMS at SQN, WBN, and BLN meet the last definitive NRC statement of acceptable compliance to "federal guidelines."

4.11.7 Station/Shield Building Vent Stack RMS

The concern contains a specific reference to the "Shield Building vent stack," which includes normal and accident range monitors for noble gases, airborne iodine, and particulates. The Shield Building exhaust vents at each plant generally provide a release pathway for such facilities as the containment purge, annulus purge, and emergency gas treatment systems.

The evaluation team compared the quantity and sensitivity of the normal SQN, WBN, and BLN station (i.e., Shield Building) exhaust vent monitoring system with equivalent vent exhaust radiation monitoring systems on other representative plants licensed for operation. The "Shield Building vent stack" RMS (or the "Station Vent Stack" for BLN) includes both normal and accident range monitors for noble gases, airborne iodine, and particulates. The BLN station vent stack also provides a release pathway for the BLN Auxiliary Building ventilation systems.

Evaluators compared the quantity and sensitivity of each plant's station vent monitoring system with plant and monitoring systems at other representative plants that are licensed for operation. The SQN, WBN, and BLN exhaust monitors were found to be comparable to those of the other PWR plants studied. The following table presents the results of this comparison:

VENT EXHAUST MONITOR COMPARISON

Plant	Quantity/ Unit	Sensitivity (uCi/cc)		
SQN, WBN	1	10^{-6} Kr-85	10^{-9} Cs-137	10^{-9} I-131
BLN	1	3×10^{-7} Kr-85	2×10^{-11} Cs-137	1.6×10^{-11} I-131
Palo Verde	1	10^{-6} Kr-85	10^{-9} Cs-137	10^{-9} Ba-133
San Onofre	1	10^{-7} Xe-133	10^{-12} Cs-137	10^{-11} I-131
SNUPPS	1	10^{-7} Xe-133	10^{-12} Cs-137	10^{-11} I-131

The above differences in sensitivity are attributed to the same factors previously discussed. It should be noted that differences in plant configurations do not allow for the other plants to make use of their plant vent monitors to also monitor containment vents, as is the case at SQN and WBN. These other plants monitor containment vents separately, some with redundancy. This redundancy may be due to a particular use of RMS in postaccident monitoring or, as in the case of SNUPPS, to an effort to err on the conservative side to avoid future changes on several plants using a standardized design. Whatever the reasons, present regulatory requirements do not require or suggest redundancy. From the review conducted, and considering the variables regarding this parameter, the table above shows that SQN, WBN, and BLN are equivalent to other licensed units and remain consistent with their respective SERs.

4.11.8 Post Three Mile Island Changes

Following the incident at Three Mile Island, the NRC published a series of guidance documents that built upon the lessons learned (Ref. 175) and initiated an action plan (Ref. 176) to institute changes. Two of these changes affected the TVA nuclear plants: NUREG-0737 (Ref. 177) and Regulatory Guide 1.97 (Ref. 164).

Both NUREG-0737, Supplement 1, and Regulatory Guide 1.97 (R2) resulted from lessons learned at Three Mile Island. Where NUREG-0737, Supplement 1, required the addition of RMS capability, Regulatory Guide 1.97 dealt with how monitoring information was to be employed in following the course of an accident. These postaccident monitoring (PAM) requirements mostly made use of instrumentation already in the plants but, in many cases, added requirements (e.g., seismic and environmental qualification) that necessitated new procurement at TVA facilities.

The NRC Regulatory Guide 1.97 requires that (1) plant variables and systems be monitored over their anticipated ranges for accident conditions as appropriate to ensure adequate safety, and (2) the reactor containment atmosphere, critical component areas, and effluent discharge paths be monitored for radioactivity that may be released from postulated accidents (Refs. 158 and 208). Regulatory Guide 1.97 provides guidance for plant and environs monitoring during and following an accident that is acceptable to the regulatory staff for meeting these requirements. In addition, the guide provides methods acceptable to the NRC to satisfy TMI-2 action plan requirements established by NUREG-0737 and its Supplement 1.

Each set of requirements was reviewed against the present configuration of the SQN, WBN, and BLN RMS as evidenced by the design criteria, design drawings, and purchase contract specifications. The equipment was not physically inspected.

SQN Postaccident Monitoring

NUREG-0737, Supplement 1, provided guidance that called for additional radiation monitoring capability (Ref. 185). In response, TVA added high-range and wide-range noble gas monitoring to the Shield Building vent stack RMS and extended-range ARMS inside containment. TVA did not add main steam line or safety/dump valve discharge monitors. The currently installed steam generator blowdown and condenser air ejection monitors were considered sufficient for this purpose.

Review of the design drawings (Refs. 167 through 172) and the SQN Design Criteria for RMS, SQN-DC-V-9.0 (Ref. 166) confirmed follow-through on equipment changes and additions necessary to meet NUREG-0737. The following radiation monitors are addressed by this latest version of the SQN Design Criteria:

- Condenser Vacuum Pump Exhaust Vent Monitors
- Shield Building Vent Monitors
- Auxiliary Building Vent Monitor
- Main Control Room Airborne and Area Monitors
- Main Control Room Air Intake Monitors
- Containment Building Purge Air Exhaust Monitors
- Containment Building Personnel-Hatch Monitor
- Postaccident Sample Room Monitor
- Fuel Pool Monitors
- Steam Generator Blowdown Line Monitors
- Residual Heat Removal Line Monitors
- Reactor Coolant Drain Discharge Monitors.
- Station Sump Discharge Monitor

- o Plant Liquid Discharge Monitor
- o Containment Building Floor and Equipment Drain Sump Discharge Monitors
- o Containment Building Upper and Lower Compartment Monitors

Tables 9.0-1 and 9.0-2 of the design criteria augment the FSAR tables and show that the additional RMS equipment meets NUREG-0737, Supplement 1, requirements.

In 03/82, TVA submitted a response to the PAM Requirements of the Regulatory Guide 1.97 (Ref. 186). Correspondence and documentation following the 03/15/82 submittal (Refs. 187 through 191) indicate that TVA has programs in place that are making assessments and modifications to what will be implemented at SQN to meet Reg. Guide 1.97, Rev. 2. Final resolution and implementation of this issue are being deferred from 09/87 to the SQN unit 2, Cycle 4, outage (Ref. 191) and are not an issue in this concern. With this deferral understood as regards the qualitative aspects of the SQN RMS and the addition of the NUREG-0737, Supplement 1, equipment outlined above, SQN has a sufficient quantity of RMS equipment to meet the minimum requirements of Regulatory Guide 1.97.

WBN Postaccident Monitoring

In 1986, TVA completed an analysis for SQN to determine the variables needed to satisfy the guidelines of Regulatory Guide 1.97, Revision 2 (Refs. 188 and 196). Because of the similarities between SQN and WBN and the minor changes between Revision 2 and Revision 3 of Regulatory Guide 1.97, this analysis should also apply to WBN insofar as it generally establishes the PAM radiation detection variables needed for WBN. The radiation detection variables established by the analysis for WBN are:

- o Main steamline radiation level
- o Containment Building radiation level - upper and lower compartments
- o Shield Building exhaust radiation level
- o Essential raw cooling water radiation level
- o Main control room radiation level
- o Auxiliary Building vent radiation level
- o Letdown radiation level
- o Liquid waste disposal effluent radiation level

- o Condenser vacuum exhaust radiation level
- o Radiation exposure meters (continuous and fixed locations)

Comparison of these variables with those being monitored at WBN, as given in Table 30, Attachment D, shows that all of the above variables are being monitored, with the exception of accident range radiation levels in the upper and lower compartments of the Containment Building. However, TVA has committed to provide this capability (Refs. 194 and 195), and the NRC has accepted TVA's design, subject to verification of the equipment installation (Ref. 197). WBN as-built drawings and instrument lists (Refs. 198 and 199) show that these containment monitors have been installed.

BLN Postaccident Monitoring

NUREG-0737 (Ref. 177) and Regulatory Guide 1.97 (Ref. 164) requirements were reviewed against the present configuration of the BLN RMS, as evidenced by the design criteria (Ref. 220) and design drawings (Ref. 219). A walkdown inspection of the equipment was also conducted (Ref. 223). NUREG-0737, Supplement 1, provided guidance that called for additional radiation monitoring capability. In response, TVA added high-range and wide-range noble gas monitoring to the BLN station vent stack RMS and extended-range ARMS inside containment. At BLN, TVA also added main steam line monitors. With the addition of the NUREG-0737, Supplement 1, equipment committed to in References 194 and 195, BLN has sufficient RMS equipment to meet these minimum requirements of Regulatory Guide 1.97.

4.11.9 Area Radiation Monitors (ARMS)

While the concern clearly refers to the PERMSS, it did not specifically exclude the ARMS. Because the ARMS detects only mean gamma radiation levels to preestablished guidelines limits, the type of equipment used is fairly uniform from plant to plant. The quantity and location of such detection equipment, however, is unique to plant type (BWR or PWR) and individual plant procedures and arrangements. Therefore, comparison of one plant's ARMS with other units does not provide fully verifiable conclusions. However, a general correlation as to equipment parameters is possible.

SQN and WBN ARMS

The ARMS for each plant is described in SQN FSAR Section 12.1.4 and WBN FSAR Section 12.3.4.1. The equipment described has the same features commonly found in other state-of-the-art systems (e.g., G-M detectors, built-in check sources, five-decade range, alarms, annunciation, recording, etc.).

The adequacy of the ARMS was reviewed in Section 12.0 of the SQN SER.

> "Twenty area radiation monitors are provided throughout the plant in areas in which personnel may routinely work without direct health physics supervision and in areas where their [sic] is a possibility of noble gas activity in concentrations that are a significant fraction of those given in 10 CFR Part 20, Appendix B, Table I. Additionally, two monitors provide for monitoring near the containment air locks and two monitors provide for personnel safety during fuel loading and refueling. The monitors are of sufficient sensitivity to detect minor changes in radiation levels. Each monitor has local and control room ratemeters and local and control room alarms. Local alarms are audible and visible. Instrumentation calibration checks will be performed, and dose rate levels will be recorded, in the control room.
>
> Based on the location of area monitors, their sensitivity and range, and their alarm annunciation and recording devices, we conclude that the area monitoring program will provide satisfactory radiological protection to inplant personnel."

The above description closely parallels the objective and design bases of the WBN ARMS, which states:

> "The area monitoring system assists in compliance with 10 CFR 50, Appendix A, General Design Criteria 19, 63, and 64."

Monitors are provided throughout the plant to monitor exposure rates and to warn personnel of increasing radiation levels. Monitors are placed as follows:

- In areas where personnel routinely work without continuous health physics surveillance, if the area is or could become a radiation area during normal operation
- In a few selected locations in the Auxiliary Building to provide knowledge of any increasing trends in general plant exposure rate levels. These monitors also provide warning of hazardous airborne noble gas concentrations
- In specific areas where exposure rates are normally low but in which high exposure rates could occur under postulated anticipated operational occurrences or accident conditions
- At locations outside the Shield Building at which detected exposure rates can provide a measure of airborne concentrations in the containment under postulated accident conditions

- In the control room to indicate exposure rates during accident conditions

The number of area radiation monitors at SQN and WBN was compared with the number at SNUPPS, Palo Verde, and San Onofre. The number of monitors used at SQN (20) and WBN (24) was a bit less than at the other PWR plants reviewed. This difference could be governed by differences in plant arrangements, operating procedures, and health physics programs. For example, San Onofre has 25 monitoring locations identified. Palo Verde had only 12 "non-ESF" area monitors and four "ESF" monitors. This is roughly equivalent to SQN; however, Palo Verde also makes extensive use of area monitors for PAM. This unique application of an additional 27 monitors is not germane to SQN.

On the basis of this review, the evaluation team could not establish any evidence that would conflict with the above NRC SER finding and concluded that the SQN ARMS has "enough radiation detection" to "meet federal guidelines." The similarity of SQN and WBN station designs drew similar results.

BLN ARMS

In accordance with BLN FSAR Section 12.3.4 (Ref. 218), the BLN area radiation monitors are provided to support the requirements of 10 CFR 50, Appendix A, General Design Criteria 19, 63, and 64. They also assist in the BLN program of keeping in-plant occupational exposures as low as reasonably achievable (ALARA), as stipulated by Regulatory Guide 8.8. This is consistent with the design intents more completely outlined for SQN and WBN above. Design drawing 2GW0900-IR-7, R12 (Ref. 219), indicates BLN units 1 and 2 should have a total of 76 fully installed area radiation monitors. The evaluation team walkdown inspection reported that 60 percent of the monitors were installed (Ref. 223). When installed, the monitors compare favorably with those at the other PWR plants reviewed.

4.11.10 Summary of SQN, WBN, and BLN Evaluations

The evaluation team found that the present SQN, WBN, and BLN radiation monitoring systems meet the normal operating requirements of 10 CFR 20 and 10 CFR 50, including both Appendix A and Appendix I, and Regulatory Guide 1.21. The validity of the initial NRC SER has been confirmed. The present RMS at each site is being modified and expanded to meet the requirements of NUREG-0737 and NUREG-0737, Supplement 1. The Shield Building Vent Stack RMS at each site also has sufficient equipment to meet 10 CFR 20, 10 CFR 50, and Regulatory Guide 1.21 requirements. These stack vents RMS also are in the process of or have been modified and expanded to meet NUREG-0737 and NUREG-0737, Supplement 1, post-TMI requirements. Some confusion about the RMS configuration may have occurred because of the documentation discrepancies between the various design criteria and design drawings and the FSARs. The FSARs should be updated to reflect the post-TMI improvements.

4.11.11 BFN Evaluation

Using the interpretation of scope in Section 4.11.2, the evaluation team reviewed the entire BFN RMS, including those detectors added specifically for postaccident monitoring.

BFN Radiation Monitoring System (RMS)

During the BFN design phase, TVA did not prepare a design criteria document for the RMS. Rather, TVA used the General Electric "Design and Analysis Report" (Ref. 202) for the RMS design basis. Recently TVA initiated the preparation of design criteria for the BFN RMS, but the document is still in draft form (Ref. 203). The following brief description of the RMS design was prepared on the basis of the BFN FSAR, design drawings, and the plant instrument list (Refs. 204, 205, and 206). This approach and the fact that radiation exposure problems are different for BWRs caused the evaluation team to approach the BFN RMS somewhat differently.

BFN Process Radiation Monitoring System (PRMS)

Radiation monitors are provided for various process streams that may serve as discharge paths to the environs for radioactive materials. A brief description of the process monitors provided follows:

- Main steamline monitors (RE 90-136, -137, -138, -139) - to monitor for gross release of fission products from the fuel and, upon indication of such failure, to initiate appropriate action to limit fuel damage and to contain the released fission products.

- Air ejector offgas monitors (RE 90-157, -160, -265, -266) - to monitor condenser offgas to determine when limits for the release of radioactive material to the environs may be approached and to initiate appropriate control so that the limits are not exceeded.

- Stack gas monitors for wide-range gamma activity (RE 90-147, -148), low-range particulate, iodine, and noble gas activity (RE 90-335, -336, -344A) and high-range particulate, iodine, and noble gas activity (RE 90-337, -338, -344B) - to indicate the rate of radioactive material released during planned operations, indicate when the limits on release of radioactive materials are reached or exceeded, and monitor the effluent released during accident conditions.

- Process liquid monitors for the raw cooling water system discharge (RE 90-132, -132A), reactor building closed cooling water system (RE 90-131, -131A), residual heat removal service water system (RE 90-133, -133A, -134A), and the common liquid radwaste system discharge (RE 90-130) - to indicate when operational limits for normal release of radioactive materials to the environs are reached, and initiate appropriate action so that limits are not exceeded.

- Ventilation exhaust monitors for the Reactor Building, Turbine Building, and refueling zone exhaust ducts (RE 90-250-1, -250-2, -250-3), for the refueling zone exhaust (RE 90-140, -141), for the reactor zone exhaust (RE 90-142, -143), for the Turbine Building exhaust roof ventilators (RE 90-249-1, -249-2, -249-3, -251-1, -251-2, -251-3), for the Radwaste Building exhaust duct (RE 90-252-1, -252-2, -252-3), and for the Radwaste Evaporator Building exhaust duct (RE 90-270-1, -270-2, 270-3) - to record the release of radioactive materials from the plant buildings to the environs and to alarm when preset limits are reached.

The PRMS monitors, as described in the BFN FSAR, are listed in FSAR Table 7.12-1. In addition, there is a control room isolation radiation monitoring subsystem that monitors the fresh air supply ducts to the control rooms and provides an isolation signal upon high radiation reading.

BFN SER Findings

Because many features of the BFN facility are similar to those evaluated and approved previously by the NRC, the NRC elected to use these previous evaluations to support their operating license review of Browns Ferry. The NRC review of the RMS as reported in the BFN SER (Ref. 207) was based on a comparison of the BFN design with that of the Pilgrim Nuclear Power Plant which had been reviewed previously and found acceptable. This approach parallels that taken by the evaluation team in comparing SQN, WBN, and BLN with San Onofre, Palo Verde, and SNUPPS. Using this approach, the NRC found that the design of the systems provided at BFN for control of radiological effluents from the plant:

> ". . . will be able to control the release of radioactive wastes from the station within the limits of the Commission's regulations (10 CFR 20) and that TVA will operate the facility in such a manner as to reduce radioactive releases to levels that are as low as practicable within the contemplation of the Commission's regulations in 10 CFR Part 50."

The evaluation team compared the NRC's SER approach and analyses against the Federal Guidelines outlined earlier and found nothing to contradict the finding.

BFN Provisions for Postaccident Radiation Monitoring

In its letter of 09/13/79, the NRC requested all operating nuclear plant owners, including TVA, to commit to the requirements of NUREG-0578. The radiation monitoring requirements of this document provided an advance statement by the NRC of requirements to be included in a future revision of Regulatory Guide 1.97. The requirements covered:

- Noble gas effluent monitors with an extended range designed to function during an accident
- Effluent monitoring of radioiodines for the accident condition
- Redundant in-containment high-range radiation monitors

In a TVA letter dated 10/17/79 (Ref. 209), TVA committed to comply with these requirements.

Subsequently, the NRC's effluent and in-containment monitoring requirements were made more explicit by the NRC's issuance of NUREG-0660, NUREG-0737, including Supplement 1, and finally Revisions 2 and 3 to Regulatory Guide 1.97.

In response to the NRC, in 10/82, TVA prepared a detailed evaluation of Regulatory Guide 1.97 requirements and an implementation plan for the Browns Ferry Nuclear Plant (Ref. 210). The plan, which was submitted to the NRC in 04/84, stated TVA positions on the radiation monitoring requirements of Regulatory Guide 1.97, Revision 3. The Regulatory Guide (RG) requirements, along with TVA's positions, are summarized below:

Effluent Monitoring.

Issue: RG 1.97 lists as BWR radioactivity variables to be monitored:

- Containment effluent radioactivity - noble gases (from identified release points including the standby gas treatment system vent)
- Effluent radioactivity - noble gases (from buildings or areas where penetrations and hatches are located, e.g., secondary containment and auxiliary buildings and fuel handling buildings that are in direct contact with primary containment)

TVA Position:

"The Browns Ferry plant is designed to have one designated release point; namely, the stack. The secondary containment features of the plant will isolate and/or realign to cleanup systems which exhaust to the designated release point. Therefore, there is a very low probability of a major release of activity within other plant zones such as the turbine building. If an accidental release does occur in other areas, a high-radiation alarm is received and the effluent vent dampers (variable 024) and fans can be quickly isolated. Since release paths such as the turbine building vents do not have cleanup systems, the isolation and/or shutdown of these ventilation system exhausts are stopped since it is not possible to determine quantitative releases."

TVA has committed to installing a system to monitor the Browns Ferry stack for high-range noble gas with particulate and iodine collection on appropriate collection media in response to NUREG-0737, Supplement 1, Items II. F.1.1 and II.F.1.2 (Ref. 211). TVA's position is that this system encompasses the scope of the RG 1.97 effluent monitoring requirements stated above, as well as the remainder of the RG 1.97 requirements for monitoring airborne radioactive materials released from the plant (Ref. 210).

Radiation Exposure Rate.

Issue: RG 1.97 specifies that radiation exposure rates over the range of 10^{-1} R/hr to 10^{4} R/hr be monitored inside buildings or where access is required to service equipment important to safety.

TVA Position:

"In general, access is not required to any area of the secondary containment in order to service equipment important to safety in a postaccident situation. If and when accessibility is reestablished in the long term, it will be done by a combination of portable radiation survey instruments and postaccident sampling of the secondary containment atmosphere. The existing lower range (10^{-1} to 10^{3} mr/hr) area radiation monitors would be used only in those instances in which radiation levels were very mild.

Since access to a harsh environment area to service safety-related equipment during an accident is not required, this parameter should be modified to allow for existing area radiation monitor[s] with lower range."

Therefore, the high-range radiation exposure rate monitors will not be implemented (Ref. 210).

Primary Containment Radiation.

Issue: RG 1.97 specifies that radiation exposure rates over the range of 1 R/hr to 10^{7} R/hr be monitored inside the primary containment area.

TVA Position: TVA has agreed to provide the appropriate monitors to cover the range specified (Ref. 209).

Secondary Containment Radiation.

Issue: RG 1.97 specifies that the Reactor Building or secondary containment area radiation should be monitored over the range of 10^{-1} to 10^{4} R/hr. This range was established to detect a significant release from the primary containment.

TVA Position:

> "The use of local radiation monitors to detect a breach or leakage through primary containment penetrations is inappropriate. In general, radiation in the secondary containment will be largely a function of radioactivity in primary containment and in the fluids flowing in ECCS piping, which will cause direct radiation shine on the area monitors. Also, because of the amount of piping and the number of electrical penetrations and hatches and their widely scattered locations, local area radiation monitors could give ambiguous indications. The proper way to detect a breach of containment is by using the stack noble gas monitors. . . . therefore, the reactor building area radiation monitors will not be implemented." (Ref. 210)

The NRC responded to the above positions in a letter dated 01/23/85 (Ref. 212). The NRC found that, for some items, the justification provided for deviation from or exception to the specific requirements of Regulatory Guide 1.97 is acceptable. However, for other items, the NRC concluded that there was insufficient information and inadequate justification to support the TVA position. Therefore, TVA was requested to provide additional information for those items that were not acceptable. TVA did so in a letter dated 05/07/85 (Ref. 213). The letter included some corrections to TVA's original response to Regulatory Guide 1.97, Revision 2.

To date, the NRC has not responded to TVA's 05/85 letter. Furthermore, the evaluation team found no other documents by the NRC that explicitly agreed to or disagreed with TVA's Regulatory Guide 1.97 positions on radiation monitoring. Rather, the correspondence dealt only with TVA's earlier commitments to TMI Action Items II.F.1.1, II.F.1.2, and II.F.1.3 as defined by NUREG-0737 and its Supplement 1. (These items cover noble gas effluent monitoring, monitoring for postaccident release of iodines and particulates, and containment high-range monitoring, respectively.) Thus, there is still an open question concerning the acceptability of TVA's planned implementation of postaccident radiation monitoring at BFN.

Installation Status of BFN Postaccident Radiation Monitors

TVA is required by the NRC to have the high-range noble gas and iodine effluent monitoring system and the high-range containment monitoring system installed and operational prior to the next cycle startup for each unit.

Currently, installation of the high-range effluent monitoring system for all three BFN units is nearing completion. The initial contract to supply the system went to Gull Engineers, Inc. However, the system supplied did not perform satisfactorily, and TVA let a new contract to modify and retest the system. The current plan is to use the new system for both normal plant operations and for postaccident monitoring. The original GE-supplied monitors will be used in parallel with the new system (Ref. 214).

The redundant high-range containment monitors have only been installed in unit 1 and these monitors are not fully operational (Ref. 215). TVA has determined that the design of necessary cable connections to the drywell penetration for the installation of these monitors is inadequate and that full environmental qualification of the installed equipment is questionable (Ref. 216). Work is in progress for the system in unit 2. To expedite the completion on unit 2, TVA is considering using the penetrations for the originally installed monitors (RE-90-272A and -273A), because these have been environmentally qualified and will no longer be required after the new system is installed (Ref. 217).

Area Radiation Monitoring System (ARMS)

A number of radiation monitors are provided to monitor for abnormal gamma radiation at various locations in the Reactor Building, Turbine Building, and Radwaste Building. These monitors annunciate alarms when abnormal radiation levels are detected. The plant areas where these monitors are located are tabulated in FSAR Table 7.13-2. Annunciation and indication are provided in the control room.

In addition, air particulate monitoring units and local radiation monitoring units are located throughout the plant. The air particulate monitors alarm locally and in the main control room. The local radiation monitors provide a means whereby personnel engaged in work where physical contact with radioactive materials may be required can monitor their own exposure accumulation near their work location. Each monitor is located where operators can conveniently scan clothing, hands, and feet.

Summary of BFN Evaluation

On the basis of the current installation status of postaccident radiation monitoring equipment and the foregoing evaluation, the evaluation team found that the concern is valid for the Browns Ferry Nuclear Plant. However, the present BFN RMS meets the normal operating requirements of 10 CFR 20, 10 CFR 50 (including both Appendix A, and Appendix I), and Regulatory Guide 1.21. Furthermore, upon completion of the RMS modifications currently in progress, the RMS will also meet the postaccident radiation monitoring requirements of NUREG-0737, Supplement 1, and conform to specific guidelines of Regulatory Guide 1.97. At this point, there may be sufficient radiation monitoring equipment in the plant to meet federal regulations and guidelines, in which case the concern will no longer be valid. However, for this to be the case, TVA must obtain formal agreement from the NRC to TVA's stated exceptions to Regulatory Guide 1.97.

4.12 Panel Instrument Distance - Element 229.12

4.12.1 Overview

This concern, which states that the distance between sensing instrumentation and the associated control panels is too great, was originally raised on WBN. It is considered applicable to SQN, BFN, and BLN because of the general nature of the concern. NRC identified the concern from a review of Quality Technology Company (QTC) files. The specific QTC file relating to this concern could not be identified.

TVA Design Guide (Ref. 226) terminology distinguishes between "control panel" and "instrument rack" or "instrument panel," the latter being wall-mounted. The use of the phrase "from the equipment they control" in the concern suggested that only the "control panels" were too remote from the controlled equipment. However, the notion of remote "instrument racks" or "instrument panels" resulting in long sensing lines is entertained as a presumed secondary issue.

4.12.2 Control Panels

Centralized control of large plants with complex system interactions is a well established practice. Localized control is usually restricted to testing and maintenance functions (e.g., setting of limit switches, breakers for power disconnect, etc.). Travel time of electrical control signals is irrelevant for all hydraulic and thermodynamic processes and mechanical equipment encountered. Process and equipment response times are several orders of magnitude longer.

Indicating instrumentation in the centralized control room for each plant makes visual observation of the controlled equipment unnecessary. Many process parameters are detectable only by sensors and would not be apparent by observation of the equipment.

Visual observation is required in some instances (physical positioning). Where this is necessary but access is restricted, closed circuit television (CCTV) or mirrors may be employed (e.g., radwaste and irradiated fuel handling, containment survey). These are exceptions to the usual controls in nuclear power plants.

4.12.3 Instrument Racks/Panels

Instrument racks/panels containing transmitters are usually located as close as possible to the process being sensed. Proper installation of liquid-filled instrument sensing (impulse) lines avoids the inclusion of compressible fluids. Where fluid motion is unnecessary, as in differential pressure type level instrumentation, the subcooled medium propagates the pressure signal at response times that are orders of magnitude shorter than the time it takes process variables to change.

Where fluid motion is required, as in liquid displacement type level instrumentation, the response time and sensing line length are considered in the design. Still, for economic and other reasons, it is desirable to have the instrument racks and panels as close as practical to the process sensing point.

4.12.4 SQN and WBN Evaluation

The type of controls required in the main and auxiliary control room for safe plant operation is described in FSAR Section 7.0 (Ref. 227 for SQN and 238 for WBN). Human factors engineering (HFE) practices per TVA Design Guides (Refs. 228, 229, and 230) and NRC Reports (Refs. 231 and 232) have been applied to ensure operability. Verification of HFE compliance is confirmed by ECSP Subcategory Report 20800 (Ref. 233).

NRC General Design Criterion 21 (Ref. 234) requires protective system designs that allow periodic testing. NRC Regulatory Guide 1.22 (Ref. 235) and IEEE Standard 338-1977 (Ref. 236) require these tests to include the control system response times. These tests have been performed on SQN, and any response time deficiencies have been corrected. Similar testing will be performed on WBN prior to fuel load. No TVA design criteria, NRC regulatory guides, notices, bulletins, or industry standards could be identified that limit the distance of controls or instruments from associated equipment or sensors. The Nuclear

Plant Operating Experience Inc. reports (Ref. 237) were reviewed for SQN to assess any response time problems. None were found on either unit that related to line length.

TVA Policy Memorandum PM 86-02 (Ref. 121) requires that final calculations be prepared to establish technical design adequacy and to ensure compliance with the plant design basis. WBN has initiated a field walkdown and verification program as required by TVA Engineering Requirements Specification ER-WBN-EEB-001 (Ref. 242), Section 3.1.2, which ensures that sensing line lengths are minimized on that plant.

4.12.5 BFN Evaluation

A walkdown performed at BFN identified instrument impulse line installations that have lengths greater than 120 feet but less than 130 feet for the longest installations. Because differential-pressure-type instruments are used, liquid movement in the impulse lines is not necessary to sense changing level. Therefore, even though the lines seem long, they are acceptable. This acceptability, however, is contingent on meeting proper and related installation slope requirements. TVA ECSP Report 17300 (Ref. 240) discusses an informal summary document recommending that a walkdown program be performed to verify sensing line slope with any unacceptable installations being corrected. This walkdown program (ref. Corrective Action Tracking Document 17300-BFN-05), as of 03/31/87, has no scheduled date of completion.

The type of controls required in the main and auxiliary control room for safe plant operation is described in the BFN FSAR, Section 7.0 (Ref. 241). Regulatory Guide 1.22 and IEEE Standard 338-1977 require tests to include control systems responses times. However, no BFN commitment to these standards could be established (Ref. 262).

IEEE Standard 279-1968 (Ref. 108) requires that the protective system, with precision and reliability, automatically initiate appropriate protective action whenever a condition monitored by the system reaches a preset level. No TVA design criteria, NRC regulatory guides, notices, bulletins, or industry standards could be identified that specifically limit the distance of controls or instruments from associated equipment or sensors. The Nuclear Plant Operating Experience Inc. reports (Ref. 243) were reviewed for BFN response time problems. None were found that related to line length.

4.12.6 BLN Evaluation

A walkdown performed at BLN identified instrument impulse line installations that have lengths greater than 100 feet but less than 150 feet for the longest installations. As pointed out for BFN above, differential-pressure-type instruments do not require liquid movement in the impulse lines to sense changing level/pressure. Therefore, even though these lines seem long, they are acceptable contingent upon meeting proper slope requirements. TVA ECSP Report 17300 (Ref. 240) stated that, after the instrument line installations were inspected in the BLN Containment and Auxiliary Buildings and the main steam safety valve room in unit 1, the generic applicability of instrument line slope was not substantiated as a problem at BLN.

The type of controls required in the main and auxiliary control room for safe plant operation is described in the BLN FSAR Section 7.0 (Ref. 244). Human factors engineering practices per TVA Design Guides (Ref. 228, 229, and 230) and NRC Reports (Refs. 231 and 232) have been applied to ensure operability.

NRC Regulatory Guide 1.22 and IEEE Standard 338-1977 require tests to include the control system response times. The tests have been performed, and all response time deficiencies have been corrected. No TVA design criteria, NRC regulatory guides, notices, bulletins, or industry standards have been identified that specifically limit the distance of controls or instruments from associated equipment or sensors.

4.12.7 Summary of Evaluations

The evaluation team found that TVA's instrument and control configuration was consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or safe, efficient operation of equipment because of remoteness could be established. Further, no adverse effects on response time with properly installed liquid-sensing (impulse) lines could be established. Installation of instruments to ensure these points is the subject of separate inquiry at TVA.

No NRC, TVA, or industry regulations or standards could be found that clearly and specifically establish distance limits between equipment and control panels/instrument racks. The NRC requires periodic functional testing of controls and instrumentation, including response time, of protective systems. On SQN, these tests have been performed and any deficiencies corrected.

WBN has initiated a field walkdown and verification program as required by TVA Engineering Requirements Specification ER-WBN-EEB-001, Section 3.1.2, which ensures that sensing line lengths are minimized on that plant.

Further, TVA Policy Memorandum PM 86-02 requires that final calculations be prepared to establish technical design adequacy and to ensure compliance with the plant design basis. TVA has also committed to a testing program on WBN that meets the requirements of Regulatory Guide 1.22. Any response time deficiencies made evident by this program will be corrected before fuel load.

5. CORRECTIVE ACTIONS

Table 2 indicates that 14 negative findings require corrective action. Since some of the corrective actions apply to more than a single plant, only ten different corrective actions are required to remedy the 14 findings. The detailed corrective actions are described in Attachment B. A condensation of this information by element, with the applicable plant identified in parentheses, follows:

- 229.1, Calculation of Orifice Sizes
  - Perform loop accuracy calculations and compare results to defined safety limits (SQN, WBN, BFN, BLN).
- 229.2, Panel Drains
  - Review as-built panel drawings and modify potentially radioactive panel drains as appropriate (BFN).
- 229.3, Circulating Water
  - Complete wiring change associated with replacement of flow transmitter FE-27-98 (WBN).
- 229.5, Control Air System
  - Perform analysis to determine LOCA and non-LOCA safety function dependence on auxiliary control air (ACA) inside containment (SQN).
  - Perform modifications to protect the ACA subsystem from potential damage and unacceptable impairment of ACA function in the event of a high energy pipe break under single ACA failure conditions (SQN).
- 229.9, Acoustics Monitoring
  - Revise FSAR to reflect additional information concerning the loose parts monitoring system (WBN).
- 229.10, Mercury Switches
  - Document justification for "use as is" or replace mercury switches in diesel generator support systems with switches containing no free mercury (BFN).

- <u>229.11, Radiation Monitoring</u>

  - Revise FSAR to reflect addition of postaccident monitoring equipment to plant (SQN).
  - Revise RMS design documents and FSAR to eliminate inconsistencies (WBN, BLN).
  - Complete installation and checkout of postaccident monitoring equipment (BFN).
  - Track open licensing issue on RG 1.97 until resolved with NRC (BFN).

The corrective actions above also appear in Table 33, Attachment D, along with their corresponding finding/corrective action classifications. The table indicates the plant or plants to which a corrective action is applicable by the Corrective Action Tracking Document (CATD) column where the applicable plant is identified by the CATD number, or in parentheses if no CATD exists.

From the finding/corrective action classification column of Table 33, it can be seen that of the 10 corrective actions identified, four require hardware or plant modification, one involves additional analysis to validate the design, one requires an evaluation to determine the subsequent action, and the remaining four require some type of documentation remedy. In addition, the CATD column of the table shows that, in most cases, a particular corrective action is applicable to only a single plant. The corrective action for element 229.1, which involves performing loop accuracy calculations, and the corrective action for element 229.11, which involves revising design documents to remove inconsistencies, are the only corrective actions applicable to more than one plant. Finally, with respect to corrective actions, Table 33 shows that, of the ten elements in this subcategory, three require no corrective action (namely, 229.6, 229.8, and 229.12). The element requiring the largest number of corrective actions is 229.11, Radiation Monitoring, which has four.

In all cases, the evaluation team found the corrective action plans to be acceptable to resolve the findings.

6. <u>CAUSES</u>

Table 33 also identifies one or more of the most reasonable conditions for each problem requiring corrective action. For each corrective action, the primary or most important cause is identified; however, in some instances it was felt that the problem resulted from a combination of causes, each of which should be identified. Therefore, more than one definable cause is identified for some of the corrective actions. In nearly all cases, the experience of the evaluation team was used to establish the suggested causation or condition. However, whenever direct evidence linked a cause with a problem requiring corrective action, such evidence was taken into account.

For the ten corrective action descriptions listed in Table 33, 15 causal categories have been checked. These are shown in the table and totalled at the end. Two of the most frequent entries are "Inadequate Design Basis," column 8, and "Inadequate As-built Reconciliation," column 10. These two category causes, which reflect on the design process and, more particularly, on design documentation, combine to represent 6 of the 15 causes, or 40 percent of those checked. This indicates that deficiencies in the design documentation area have contributed to a number of problems and, therefore, improvement in this area appears warranted.

In addition, a number of the causal categories in Table 33, such as "Design Criteria/Commitments Not Met," column 13, "Engineering Error," column 16, and "Inadequate Calculations," column 9, combined with "Inadequate Design Basis," column 8, suggest a weakness in TVA's design review process. Besides improving the quality of the design, a stronger design review process would also be expected to remove some of the deficiencies noted above in the design documentation area.

Finally, using the three larger causal categories identified by the major headings in Table 33, the totals show that 10 of the 15 causes are in the "design process effectiveness" area. This result is consistent with the previous observations concerning TVA weaknesses in the design review and documentation areas.

However, in the case of Instrumentation and Control (I&C) additional complexities are evident. While I&C is a subgroup of the EEB, most of the problems outlined above relate to mechanical process systems (229.1, 229.2, 229.5, 229.8, and 229.12) or nuclear compliance (229.09 and 229.11). Some involved both (229.1, 229.2, 229.5, and 229.11), and only a few were solely instrument applications engineering in nature (229.3 and 229.10). This suggests that the I&C activities have not been thoroughly integrated into or coordinated with the overall design process. Additional emphasis on systems reviews, especially interfaces with MEB and NEB, is appropriate. This is discussed further in the Engineering Category Report.

7. COLLECTIVE SIGNIFICANCE

The evaluation team's judgment as to the significance of the corrective actions listed in Table 33 is indicated in the last three columns of the table. Significance is rated in accordance with the type or types of changes that may be expected to result from the corrective action. As can be seen from the significance columns, only three of the ten corrective actions for this subcategory are judged to be significant. The performance of loop accuracy calculations (element 229.1) for SQN, WBN, BFN, and BLN was classified as significant because, under certain accident conditions, flow element errors can lead to a reduction in the safety margin. Analysis is required, therefore, to demonstrate that any such reduction is acceptable. Protection of the SQN auxiliary control air (ACA) subsystem against single failure (element 229.5) was judged significant since the ACA subsystem is safety related and its availability must be assured for accident mitigation. Finally, completing the installation of the postaccident radiation monitoring equipment at BFN (element 229.11) was categorized as significant because of experience gained from the TMI accident which demonstrated the importance of such monitoring equipment under severe accident conditions.

The relatively low number of negative findings in this subcategory, the random nature of the causes, and the low significance level of the corrective actions as defined herein, could lead to the conclusion that the instrumentation and control design for the four plants investigated does not appear to represent a significant technical problem. However, there were several instances where the calculational and design bases were inadequate which indicate that the design review process should be improved. Although the TVA Corporate Nuclear Performance Plan and the followon action plan developed to date contain the elements necessary to strengthen the design review process, sufficient evidence to conclude that these weaknesses will be satisfactorily resolved is not yet clear. Further, it is not evident that the MEB/I&C design review process has been successfully integrated into the overall DNE organization as presently structured. Development of procedures for the design reviews process and their effective implementation are necessary before these questions can be fully answered.

The results of this subcategory evaluation are being combined with the other subcategory evaluations and reassessed in the Engineering category evaluation.

GLOSSARY SUPPLEMENT FOR THE ENGINEERING CATEGORY

Causes of Negative Findings - the causes for findings that require corrective action are categorized as follows:

1. Fragmented organization - Lines of authority, responsibility, and accountability were not clearly defined.

2. Inadequate quality (Q) training - Personnel were not fully trained in the procedures established for design process control and in the maintenance of design documents, including audits.

3. Inadequate procedures - Design and modification control methods and procedures were deficient in establishing requirements and did not ensure an effective design control program in some areas.

4. Procedures not followed - Existing procedures controlling the design process were not fully adhered to.

5. Inadequate communications - Communication, coordination, and cooperation were not fully effective in supplying needed information within plants, between plants and organizations (e.g., Engineering, Construction, Licensing, and Operations), and between interorganizational disciplines and departments.

6. Untimely resolution of issues - Problems were not resolved in a timely manner, and their resolution was not aggressively pursued.

7. Lack of management attention - There was a lack of management attention in ensuring that programs required for an effective design process were established and implemented.

8. Inadequate design bases - Design bases were lacking, vague, or incomplete for design execution and verification and for design change evaluation.

9. Inadequate calculations - Design calculations were incomplete, used incorrect input or assumptions, or otherwise failed to fully demonstrate compliance with design requirements or support design output documents.

10. Inadequate as-built reconciliation - Reconciliation of design and licensing documents with plant as-built condition was lacking or incomplete.

11. Lack of design detail - Detail in design output documents was insufficient to ensure compliance with design requirements.

12. Failure to document engineering judgments - Documentation justifying engineering judgments used in the design process was lacking or incomplete.

13. Design criteria/commitments not met - Design criteria or licensing commitments were not met.

14. Insufficient verification documentation - Documentation (Q) was insufficient to audit the adequacy of design and installation.

15. Standards not followed - Code or industry standards and practices were not complied with.

16. Engineering error - There were errors or oversights in the assumptions, methodology, or judgments used in the design process.

17. Vendor error - Vendor design or supplied items were deficient for the intended purpose.

Classification of Corrective Actions - corrective actions are classified as belonging to one or more of the following groups:

1. Hardware - physical plant changes

2. Procedure - changed or generated a procedure

3. Documentation - affected QA records

4. Training - required personnel education

5. Analysis - required design calculations, etc., to resolve

6. Evaluation - initial corrective action plan indicated a need to evaluate the issue before a definitive plan could be established. Therefore, all hardware, procedure, etc., changes are not yet known

7. Other - items not listed above

Peripheral Finding (Issue) - A negative finding that does not result directly from an employee concern but that was uncovered during the process of evaluating an employee concern. By definition, peripheral findings (issues) require corrective action.

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 22900

Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given, along with notation of any other element or category with which the concern is shared; the plant sites to which it could be applicable are noted; and the concern is quoted as received by TVA, and characterized as safety related, not safety related, or safety significant.

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 22900 .

ELEMENT	CONCERN NUMBER	PLANT LOCATION	SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
229.1	NS-85-004-001	WBN	X	X	X	X	"Orifice plates installed in many plant systems, both Units 1 and 2 (Watts Bar) have incorrect hole size which will result in false flow reading. This same condition may exist at Sequoyah." (SS)
	PH-85-022-001	WBN	X	X	X	X	"Orifice plates received under contract #83520-1 to Meriam Instrument Co. are in error because the bore sizes were not calculated using a flow coefficient based on Reynolds number. (Refer to L. K. Spink, 9th Edition, Foxboro Co.) I.E., Meriam Instrument Co. used the plant equation vs precise equation when calculating the orifice plates bore sizes on contract #83520-1. These orifice plates have been installed in many systems in both Units 1 & 2." (SS)
229.2	IN-85-143-003	WBN	X	X			"There are contaminated Instrument Drains going into open drains in the Raceway of both Reactor Buildings." (SR)
	IN-85-197-002	WBN	X	X			"Instrument drain lines (closed system) coming off instrument racks in Reactor Building Unit 1 raceway area are connected to open floor drains that are vented to atmosphere inside R.B. #1. CI is concerned that due to high operating temperature inside R.B. during operation that the radioactive water coming from instrument panels will evaporate causing airborne contamination to people working in or in this area." (SR)
	IN-85-514-002	WBN	X	X			"Closed drain system, 276 system, 1/2" SS drain pipe empties into floor drain with open grating in Unit 1 Reactor Building Elev. 702' raceway area between containment liner and crane wall. CI does not remember azimuth. CI is concerned that open grating on floor drain will lead to high radiation exposures to employees working in this area." (NQ)
	IN-85-748-001	WBN	X	X			"Raceway (reactor building #1 & 2) currently reactor building #2, approximately 708' elevation. The sealed drains coming off the instrument panels are being tied into regular drains rather than into radiation drains. This has been reported and no corrective action to date." (SR)
	IN-85-952-001	WBN	X	X			"Hot systems, system 62, 64 and 68, instrument panels in Unit 1, Reator Bldg., raceway area, drain into open floor drains. CI feels these panels should draw into closed (contained) drain system." (SR)

* SR/NQ/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 22900

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
229.2 (Cont'd)	IN-85-983-001	WBN	X	X			"Panels in raceway RB #1 and #2 are designed to drain into floor drain. There is a potential for release of radioactive material." (SR)
	XX-85-127-001	SQN	X	X	X	X	"Sequoyah - 'Hot' panel drains are routed into the floor drains instead of closed tanks." (SR)
229.3	IN-85-142-008	WBN		X			"Diffuser located at river does not have enough water head. Gauge should have 11", however it only reads 3". (NQ)
	IN-85-889-002	WBN		X			"CI stated that the present WBNP cooling water diffuser outlet to the river has inadequate flow monitoring instrument to measure the possible contaminated plant water discharge. The pipe line is 4'-6" diameter. The flow sensor is an annubar which is a differential flow meter. The CI added that WBNP has an EPA commitment for installing a workable flow meter about a year ago." (SR)
	IN-85-281-001	WBN		X			"Instrumentation to monitor H_2O from the diffuser (holding pond) to river is poorly located and inoperable. Affects both units." (SR)
	IN-85-115-N09	WBN		X			"NRC identified the following concern from review of QTC file: 'Malfunctioning instrumentation on plant effluent line.'" (SR)
229.5	IN-85-348-002	WBN	X	X		X	"Control air system does not appear to have sufficient volume to assure functionality if the system should experience a guillotine air line break. Individual specifically requested a description of the maximum system volume available and of appropriate backup systems." (SR)
229.6	IN-85-348-003	WBN	X	X			"Unit #1, elev. 713' pipe chase System 43 Water Quality Monitoring - has the potential to contain radioactively contaminated water under postulated accident conditions. System does not contain isolation/drain valves for controlled draining of effluent under routine/emergency maintenance conditions." (SR)

* SR/NQ/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
229.8	IN-85-772-006	WBN	X	X			"There is one flow switch (Mercoid) that indicates tank water level and adds water to tank. Operations has to work the switch manually to fill the tank. This is inefficient. One switch is needed for high water level, and one for low water level. Examples: Control Room, A5 & R line, Elev. 755, system 31. Switch 0-LS-031-17. A & B board rooms, Dwg 47W605-8 Rev 7, 737 Elev, LS-117 & LS-147. Electrical board room, Dwg 47W605-7 Rev 6, 692 El. 0-LS-31-220, 0-LS-31-223, 0-LS-31-250, 0-LS-31-253, Incore instrument room dwg 47W605-5 Rev 4, control room annunciators, LS-031-303, LS-031-324." (NO)
229.9	IN-86-080-001	WBN		X			"Acoustics monitoring system (AMS) is improperly designed. There is no backup data recorder, so when the recorder is 'down' there is effectively no AMS." (SR)
229.10	BNP-QCP-10.35-18	BLN	X	X	X	X	Mercury Switches in Diesel Generator Building. Not concerned with mercury contamination. Thinks mercury switches are not supposed to be used on nuclear plants. Taken out at SQN and replaced with other switches. (SR)
229.11	IN-85-144-001	WBN	X	X	X	X	"CI does not feel there is enough radiation detection equipment in the plant; specifically, on the radioactive process piping systems (CI did not specify system #'s) in Unit 1 and in the shield building vent stack for Unit 1. CI feels Unit 1 shield building vent stack needs more radiation monitoring equipment to meet federal guidelines." (SR)
229.12	IN-85-068-N06	WBN	X	X	X	X	"NRC identified the following concern from review of QTC file, 'A lot of instrument panels are located far away from the equipment they control.'" (SR)

* SR/NO/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ATTACHMENT B

SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS FOR SUBCATEGORY 22900

Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 33 by using the CATD number which appears in Attachment B in parentheses at the end of the corrective action description.

The term "Peripheral finding" in the issue column refers to a finding that occurred during the course of evaluating a concern but did not stem directly from an employee concern. These are classified as "E" in Tables 1 and 2 of this report.

Issues	Findings	Corrective Actions
****************** Element 229.1 - Calculation of Orifice Sizes ******************		
SQN	SQN	SQN
a. Flow element orifice plates have incorrect hole sizes which will result in false flow readings.	a. Calculations performed by the evaluation team on flow elements that come under the required accuracy definition of TVA Design Standard DS-E 18.1.10 established differences between 2 percent and 3 percent of full scale flow. This difference was judged by the evaluation team to be too small to be considered "false," as defined.	a. None required.
b. Orifice plates furnished by Meriam Instrument Company are not properly sized because the supplier (Meriam) used the "plant" calculational method, which does not compensate for such things as Reynolds Number, instead of the "Precise" method, which does. These Meriam orifice plates have been installed in many systems.	b. Whether the orifice plates in question are "properly sized" depends on their intended design purpose. Of the 139 Meriam plates installed at SQN no misapplication based on improper sizing could be established. However, errors due to use of the "Precise" vs. the "Plant" sizing methods were not considered in TVA accuracy calculations.	b. The TVA SQN Corrective Action Plan (CAP), TCAB-045 (12/30/86), has been reviewed. In summary, the CAP commits to reviewing and revising the SQNP safety calculations for flow measurement developed from orifice plates, to accommodate potential errors introduced by sizing calculational methods. This review process constitutes an acceptable corrective action on this issue. The TVA SQN CAP was revised so that the corrective action is not required for restart. The basis was a calculation review which determined that the inaccuracies are insignificant. The calculations will be revised after restart. This revised CAP is acceptable. (CATD 229 01 SQN 01)
WBN	WBN	WBN
a. Flow element orifice plates have incorrect hole sizes which will result in false flow readings.	a. No instances of orifices having improper hole sizes resulting in "false" flow readings were found. Reviews of system functions, specifications, and orifice contracts did identify instances of incorrect design parameters which were later corrected or which resulted in inaccuracies that are within the requirements of the flow measurements. Flow elements FE-67-222 and 226, which were addressed in NCR4412R, are examples.	a. None required.

Issues	Findings	Corrective Actions
Element 229.1 - WBN (Continued)		
b. Orifice plates furnished by Meriam Instrument Company are not properly sized because the supplier (Meriam) used the "plant" calculational method, which does not compensate for such things as Reynolds Number, instead of the "precise" method, which does. These Meriam orifice plates have been installed in many systems.	b. The orifice plates supplied by the Meriam Instrument Company were sized using the "plant" calculational method. These plates are installed in many WBN systems. The "plant" method results in a less accurate indication of flow because it does not compensate for viscous energy loss factors (e.g., Reynolds number). The "precise" method accounts for such losses and results in a more accurate, usually lower, indicated flow. These differences do not result in orifice plates that ". . . are not properly sized" when the end use of the indicated flow is considered. For example, where the purpose of the indicated flow is merely to establish the presence or absence of flow, the quantitative accuracy is not as important as in the case of control or monitoring safety variables. Calculations performed in response to these concerns on SQN by the evaluation team showed that the differences between the "plant" and "precise" methods lie in the range of 2 to 3 percent of full range flow. No calculations for loop accuracy presently exist. A program that determines the instrument loop accuracy requirements, including proper sizing by the manufacturer, is presently in progress at TVA. This program will evaluate the "plant" vs "precise" accuracy differences, along with other factors, to determine if the total loop accuracy is proper for the application intended.	b. The TVA WBN corrective action plan (CAP) TCAB-329 (03/16/87), has been reviewed. The CAP commits to completing the necessary loop accuracy calculations and comparing the accuracy to the safety limits defined by Design Standard E18.1.10. This action will implement the policy defined in Policy Memorandum PM86-02 (EEB), Electrical Calculations, dated 05/08/86. (CATD 229 01 WBN 01)
BFN	BFN	BFN
a. Flow element orifice plates have incorrect hole sizes which will result in false flow readings.	a. No elements were identified which have "incorrect hole sizes," or "false flow readings" using the definition in Section 4.3.2, for their respective applications.	a. None required.
b. Orifice plates are not properly sized because the supplier used the "plant" calculational method, which does not compensate for such things as Reynolds Number, instead of the "precise" method, which does. These orifice plates have been installed in many systems.	b. The "plant" method was used to size many of the installed orifices. This method was found to be appropriate for these applications. Previous evaluations identified differences up to 3 percent between the plant and precise calculation methods. A TVA loop accuracy verification program is now in progress for all safety-related systems. A review of a preliminary copy of the loop accuracy calculation for FE-73-33 (Ref. 261) indicates that the calculation does not yet address engineering design inaccuracies such as the difference between the plant and precise hole-sizing methods.	b. The TVA BFN corrective action plan (CAP), TCAB-439 (07/10/87), has been reviewed. The CAP commits to addressing engineering design inaccuracies in the existing loop accuracy verification program for all safety-related systems. The loop accuracies will also be related to the safety limits per DS-E18.1.10. The loop accuracy calculations are scheduled to be completed before unit 2 restart. These actions will implement the policy defined in Policy Memorandum PM86-02 (EEB), Electrical Calculations. (CATD 229 01 BFN 01)

Issues	Findings	Corrective Actions
Element 229.1 - BFN (Continued)		
c. The acceptability of orifice plates sized using the "plant" method to provide flow signals for postaccident monitoring functions is questioned. The orifice plate flow signals must be within the accuracies assumed in the design calculations.	c. The orifices providing flow signals for postaccident monitoring functions are included in the list to be evaluated by the loop accuracy verification program. Completion of these calculations and the appropriate comparison to the safety limits per DS-E18.1.10 will provide assurance of the appropriateness of these orifice hole sizes, even though all PAM functions are qualitative in nature and a hole size designed by the "plant" method would provide sufficient accuracy.	c. None required.
BLN	BLN	BLN
a. Flow element orifice plates have incorrect hole sizes which will result in false flow readings.	a. No instances of incorrect hole sizing of orifice plates were found for BLN.	a. None required.
b. Orifice plates are not properly sized because the supplier used the "plant" calculational method, which does not compensate for such things as Reynolds Number, instead of the "precise" method, which does. These orifice plates have been installed in many systems.	b. The Meriam Instrument Co. was not found to be an orifice vendor for BLN. The majority of the orifices were from the Daniel Measurement Co. and utilized the "precise" hole sizing method. Those orifices from B&W/Bailey are thought to use the "plant" method.	b. The existing Loop Accuracy Verification Program for BLN will incorporate the uncertainties associated with orifice bore hole sizing of the B&W/Bailey orifice plates in order to verify the accuracy of the loops. The calculations will also relate the loop accuracies to the appropriate safety limits per DS-E18.1.10. (No CATD)
c. Uncertainties in the orifice engineering designs have not been incorporated into the loop accuracy verification calculations per Design Standard DS-E18.1.10.	c. A Loop Accuracy Verification Program will be implemented at BLN to review all safety-related instrument loops to confirm their accuracy. The review team was informed that this program intends to incorporate the design engineering uncertainties, such as orifice bore hole sizing, in the calculations, in order to verify the accuracy of the loops. The calculations will also relate the accuracy of the loop to the appropriate safety limit per Design Standard DS-E18.1.10.	c. The existing Loop Accuracy Verification Program for BLN will incorporate the uncertainties associated with orifice bore hole sizing of the B&W/Bailey orifice plates in order to verify the accuracy of the loops. The calculations will also relate the loop accuracies to the appropriate safety limits per DS-E18.1.10. (No CATD)
****************** Element 229.2 - Panel Drains ******************		
SQN	SQN	SQN
a. There is a potential for liquid and airborne radioactive contamination spread as a result of drains from radioactive instrument and sample panels being routed to [illegible] floor drains rather than to [illegible]ed equipment drains.	a. No hot instrument or sampling panel drains were found to be piped to open floor drains. Nine instrument panels (1-L-187, 1,2-L-191, 1,2-L-358, 1-L-359, 1,2-L-360, 1-L-361) were physically identified as being connected to Rea[illegible] Building open drain headers at points lower than the[illegible]gs of floor drains	a. None required.

Issues	Findings	Corrective Actions
Element 229.2 - SQN (Continued)		
	connected to the same header. The design of the open drain headers precludes backflow and the nature of the drains inventory reduces personnel exposure potential or spread of contamination to insignificant levels. Two sampling panel drains (Cubicles 1B and 2B) were found to be similarly connected to open drain headers. No liquid waste is released from these drain systems unless it is first monitored and treated.	
WBN	WBN	WBN
a. Closed (sealed) drains from instrument panels are routed into open floor drains (regular drains) rather than the closed (contained or radiation) drain system.	a. A physical walkdown of WBN confirms that there are 20 hot instrument panels in the raceway of each reactor building that are piped into open floor drains. In addition, there are 24 hot instrument panels in reactor building 1 and 21 hot instrument panels in reactor building 2 that are connected to drain headers that have open floor drain connections. In each reactor building, the floor drains and drain headers are part of a single drainage system and discharge into the reactor building sump. This is unlike the auxiliary building where there are separate "closed" and "open" drainage systems that conduct drainage to tritiated and nontritiated drain collector tanks, respectively. No "closed" drain system, per se, exists within the reactor buildings.	a. None required.
b. There is a potential for personnel exposure to liquid and airborne radioactive contamination because instrument panels are drained into floor drains that are open to the atmosphere and are located in an area of high operating temperature.	b. Because hot panels are piped into open floor drains or into drain headers that have open floor drain connections, the potential for backflow and venting exists. However, because of the small volumes handled, the low contamination level of the effluent, the large size of the drain headers, and the elevation differences, personnel exposure due to backflow of potentially radioactive drainage into the open floor drains is very unlikely. Similarly, because of the small volumes, the tendency for dissolved gases to remain in the liquid, and the relatively low inventory of dissolved gases that would be radioactive, with good maintenance and health physics procedures the venting of such gases through the open floor drains should not present a significant personnel exposure issue under normal operating conditions. During operation, ambient temperatures inside the containment do not exceed 120°F, which is not sufficient to cause evaporation of drainage. The reactor buildings are not normally occupied during plant	b. None required.

Issues	Findings	Corrective Actions
Element 229.2 - WBN (Continued)		
	operation, when exposure potential is highest. Any entry into the reactor buildings is made under administrative control and in accordance with substantial health physics procedures. The total exposure potential within the reactor buildings is subject to continuing health physics review. At Sequoyah Nuclear Plant, which is similar to WBN, no changes have been necessary as a result of such reviews on this subject during 4 years of operation.	
c. Floor drains in the reactor building present a potential for release of radioactive material.	c. In each reactor building, floor drains discharge through drain headers into the reactor building sump. Periodically, liquid waste from the sumps is pumped to the tritiated drain collector tank in the auxiliary building. Normally, liquid waste in this tank is recycled. No liquid waste is released from this tank unless it is first monitored and treated.	c. None required.
BFN	BFN	BFN
a. Hot panel drains are discharged to open floor drains rather than into closed (portable) tanks or to a closed drainage system.	a. A physical walkdown of the panels confirms the following: o While no hot instrument panel drains are connected to floor drains, two hot sample sinks drain onto the Reactor Building floor so that the drainage will run across the floor into a floor drain. o 152 hot instrument panels which have drains have no connection to the plant drainage system. o 73 hot instrument panels and 30 hot sample sink drains are connected by gravity piping to floor drain sumps; this piping is also connected to open floor drains. o 12 hot instrument panels which have piping or tubing connections to a hot system have no drains and are not connected to the plant drainage system. o Two hot instrument panels and six hot sample sinks are connected to gravity piping through open connections (funnel drains or standpipes). o Four hot instrument panel drains are connected to station sumps. o Some of the 152 hot instrument panel and 3 hot sample sink drains which are not connected to the plant drainage system have manifolds or other drain piping which is not valved, plugged, or capped.	a. The CAP as transmitted by TCAB-400, dated 08/10/87, responds to Corrective Action Tracking Document 229 02 BFN 01 and commits TVA to the following actions: 1. Connecting the drain of Panel 1-25-126 to the radwaste floor drain system, or capping it. 2. Extending unit 1 and 2 nongenerative HTX sampling stations to the floor drain. Routing the unit 3 system to the floor drain instead of to the equipment drain system. 3. A walkdown has identified a list of drain pipes that have water seals and are subject to administrative procedures, RCI 1 and 9, to monitor any radioactive releases. The CAP, if properly implemented, is acceptable to the evaluation team. (CATD 229 02 BFN 01)

Issues	Findings	Corrective Actions
Element 229.2 - BLN	BLN	BLN
a. Hot panel drains are discharged to open floor drains rather than into closed (portable) tanks or to a closed drainage system.	a. The evaluator determined the following: o Nine hot instrument panels and one grab sample station have drains connected to a floor drain. o The floor drains are all connected to either the tritiated or nontritiated waste holdup tank. o These tanks discharge to the liquid radwaste processing equipment. o No liquid waste is released from this equipment unless it is first monitored and treated. o Potential exposure of operating personnel is insignificant.	a. None required.

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Element 229.3 - Circulating Water
****

Issues	Findings	Corrective Actions
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Instrumentation to monitor flow through the cooling water diffuser to the river has insufficient static pressure ("water head"), is poorly located, and is inadequate to measure possibly contaminated plant water discharge.	a. TVA has implemented corrective action in Field Change Request (FCR) NP-1165 (03/19/86) and related Work Plan F-NP-1165-1, R0 (05/21/86) to relocate flow transmitter FT 27-98 closer (i.e., lower) to the cooling tower blowdown pipe which leads to the diffuser at the river. This action ensures that the sensing lines of flow transmitter FT 27-98 can be filled and maintained in a "water-solid" condition and, thus, resolves the concern with inadequate static pressure (i.e., "water head").	a. The Problem Description of CATD 229 03 WBN 01 (03/03/87) states: "Wiring changes associated with the replacement of flow transmitter FT-27-98 have not been made. Flow element (annubar) FE-27-98 is inoperable." The corrective action plan (CAP) responding to CATD 229 03 WBN 01 states:

Issues	Findings	Corrective Actions
Element 229.3 - WBN (Continued)		
	TVA has replaced the flow transmitter with one that will remain functional when submerged to protect the transmitter from local flooding of the manway in which it is located (ECN NP-1165 and Work Plan F-NP-1165-1). However, wiring changes associated with the replacement and relocation of the transmitter have not been made. Rewiring will be done under ECN-6431 (08/15/86). In the process of modifications, not related to the flow instrumentation, the annubar flow element (FE 27-98) was damaged (trimmed and misaligned). This rendered the annubar inoperable, necessitating its replacement. Data Sheet No. 4 ECN-6455 (02/28/87) will implement replacement of the annubar flow element.	"Approved Engineering Change Notices 6431 and 6455 will correct instrumentation problems identified by employee concerns." Implementation of ECN-6431 will complete the replacement of flow transmitter FT-27-98, including wiring changes. ECN-6455 entails replacing the flow element and reworking the instrumentation, as required. The schedule for completion of the corrective action is before initial fuel load of WBN Unit 1 (i.e., milestone "UFL-1"). The evaluation team concurs with this corrective action. (CATD 229 03 WBN 01)
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
****************** Element 229.5 - Control Air System ******************		
SQN	SQN	SQN
a. Volume of air receivers in control air system is insufficient to ensure that control systems will function in the event of a guillotine air line break.	a. There is sufficient capacity, redundancy and isolation provision in the SQN control air systems to support systems required for safe shutdown for all design basis events originating within the ACA. No guillotine break assumptions are required in the safety-related ACA subsystem.	a. None required.

Issues	Findings	Corrective Actions
Element 229.5 - SQN (Continued)		
b. Peripheral finding.	b. However, TVA's review of high energy pipe breaks has identified a number of unacceptable interactions which could cause loss of ACA function in the event of a single failure in the unaffected ACA train.	b. Portions of the Auxiliary Control Air (ACA) subsystem piping within containment are not adequately separated from high energy piping. Certain breaks would be likely to result in failure of ACA piping, which, in combination with a single failure in the unaffected ACA train, could result in loss of ACA function. This function is required for safe shutdown following these pipe breaks. However, only one unacceptable interaction between high energy piping and ACA piping was found through recent TVA systems analyses. This interaction involved the 4-inch pressurized spray line. The corrective action plan forwarded by ICAB-101, consists of analysis which limits physical changes to the installation of an isolation plate on the train A 1-inch ACA line just upstream of the potential interactions with the 4-inch pressurizer spray line. The evaluation team concurred that satisfactory implementation of the corrective action would resolve the specific problem outlined within the scope of this evaluation. This corrective action for the problem described in CATD 229 05 SQN 01 has been completed. (CATD 229 05 SQN 01)
WBN	WBN	WBN
a. The volume of the air receivers in the control air system is insufficient to ensure that control systems will function in the event of a guillotine air line break.	a. There is sufficient capacity, redundancy, and isolation provision in the WBN control air systems to support those systems required for safe shutdown for all design basis events originating within the Auxiliary Control Air (ACA) subsystem. In accordance with NRC pipe break criteria, no guillotine break assumptions are required in the safety-related ACA subsystem. However, the statement in the first sentence would still be valid if a guillotine break were to occur in the ACA subsystem, as stated in the WBN Final Safety Analysis Report, paragraph 9.3.1.3.2.	a. None required.

Issues	Findings	Corrective Actions
Element 229.5 - SQN (Continued)		
	The evaluation team also found that there are no unacceptable potential interactions between high energy piping and ACA subsystem piping inside containment, as had been the case at SQN.	
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
a. The volume of the air receivers in the control air system is insufficient to ensure that control systems will function in the event of a guillotine air line break.	a. There is sufficient capacity, redundancy, and isolation provision in the BLN compressed air systems to support those systems required for safe shutdown for all design basis events originating within the essential air system (EAS). In accordance with NRC pipe break criteria, no guillotine break assumptions are required in the EAS. The evaluation team also found that there are no unacceptable potential interactions between high energy piping and the EAS piping, as had been the case for the comparable system at SQN.	a. None required.
****************** Element 229.6 - Water Quality System ******************		
SQN	SQN	SQN
a. Water Quality Monitoring System (43) may contain radioactive materials under certain accident conditions.	a. System 43 piping in the pipe chase was found to contain radioactive material not only during postulated accident conditions but, by design intent, during normal plant operating conditions.	a. None required.
b. Lack of isolation and drain valves does not permit controlled effluent removal.	b. System 43 piping was found to contain isolation valves. These valves are not located in the pipe chase. System 43 piping was found to contain valves that control the draining of effluent under both operating and maintenance conditions. These valves are not located in the pipe chase. Additional precautions were found to be taken to reduce personnel exposure to radioactivity to levels below the limits of 10CFR20.	b. None required.

Issues	Findings	Corrective Actions
Element 229.6 - WBN	WBN	WBN
a. Water Quality Monitoring System (43) may contain radioactive materials under certain accident conditions.	a. System 43 piping in the pipe chase was found to contain radioactive material not only during postulated accident conditions but, by design intent, during normal plant operating conditions.	a. None required.
b. Lack of isolation and drain valves does not permit controlled effluent removal.	b. System 43 piping was found to contain isolation valves. These valves are not located in the pipe chase. System 43 piping was found to contain valves that control the draining of effluent under both operating and maintenance conditions. These valves are not located in the pipe chase. Additional precautions were found to be taken to reduce personnel exposure to radioactivity to levels below the limits of 10CFR20.	b. None required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
****************** Element 229.8 - Tank Level Switches ******************		
SQN	SQN	SQN
a. Level control switches for chilled water system expansion tanks do not provide for a suitable means for automatic refilling of the tanks.	a. The present method of providing automatic makeup to the chilled water system suitably considers the relevant design and operating parameters, and is an acceptable design. Operational difficulties or excessive maintenance history for the compression tanks filling arrangement have not been documented at SQN.	a. None required.

Issues	Findings	Corrective Actions
Element 229.8 - WBN	WBN	
a. Makeup to the air conditioning chilled water system compression tanks requires inefficient manual controls. Fully automatic makeup should be provided.	a. WBN drawings show that the closed chilled water loops supporting HVAC to the following areas employ compression tanks with the identified level switches controlling makeup: o Main control room drawing 47W865-3, R9, level switches 0-LS-31-170 and 0-LS-31-195 o Shutdown board room drawing 47W865-8, R19, level switches 0-LS-31-71 and 0-LS-31-147 o Electrical board room drawing 47W865-7, R17, level switches 0-LS-31-226 and 0-LS-31-256 Physical walkdowns confirmed installation of "Mercoid" Model 2016-7810-C1-60 float-type level switches below each compression tank. These level switches control solenoid-operated inlet valves thereby providing automatic makeup. There is no provision for manual operation after initial system filling. This is similar to the techniques used successfully at SQN. The concern is not valid for these systems. The concern lists the following instruments associated with the above systems: 0-LS-031-17, LS-117, 0-LS-31-223, and 0-LS-31-253. The correct tag numbers of these instruments were found to be 0-LS-31-170, 0-LS-31-71, 0-FSV-31-223, and 0-FSV-31-253, respectively. The chilled water systems that cool the incore instrument room employ open expansion tanks (drawing 47W865-5, R14, level switches LS-31-303 and LS-31-324). WBN drawings show that these systems are not designed for automatic makeup. The function of these level switches is to alarm and to stop the chilled water circulating pumps on tank low level. Manual makeup operation is then performed by opening hand valves in the inlet line. This system does not exist at SQN. The concern is correctly expressed but not valid in this case, since the switches perform as the design originally intended.	WBN a. None required.

Issues	Findings	Corrective Actions
Element 229.8 - BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
****************** Element 229.9 - Acoustics Monitoring ******************		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. The "Acoustic Monitoring System" design basis is challenged on the absence of redundant data recorders.	a. The Loose Parts Monitoring System (LPMS) which is referred to as the "acoustics monitoring system" in the concern, is not safety-related and there is no requirement for data recorder redundancy. The LPMS will still operate and alarm if the data recorder is unavailable. A spare data recorder is available at the plant.	a. None required.
b. Peripheral finding.	b. It was found that although Regulatory Guide 1.133 requires an LPMS description in FSAR Section 4.4.5, "Instrumentation Application," the WBN FSAR includes partial information in Section 7.6.7 and other unreferenced pieces in the responses to NRC questions 221.10, 221.13, and 221.16. In addition, a required reference to the technical specifications was missing.	b. The TVA WBN corrective action plan (CAP), TCAB-211, has been reviewed. The CAP commits to revising the FSAR to reflect the LPMS information included in the response to NRC Question 221.16, and to include a reference to the applicable technical specification section. (CATD 229 09 WBN 01)
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

Issues	Findings	Corrective Actions
****************** Element 229.10 - Mercury Switches ******************		
SQN	SQN	SQN
a. Use of mercury switches in the Diesel Generator Building is a questionable practice.	a. Evidence that mercury switches were installed and then "taken out at SQN and replaced with other switches" could not be found. Documentation early in the design phase of SQN indicates that such mercury switches were, as a general practice, to be avoided. The present instrumentation installed in the Diesel Generator Building is in agreement with the TVA Design Standard DS-M18.1.2 which restricts the use of switches containing free mercury. Physical walkdown of the Diesel Generator Building at SQN verified that no mercury containing switches are presently installed.	a. None required.
WBN	WBN	WBN
a. Use of mercury switches in the Diesel Generator Building is a questionable practice.	a. The present instrumentation installed in the Diesel Generator Buildings is in agreement with TVA Design Standard DS-M18.1.2, which restricts the use of switches containing free mercury in safety-related systems or components of nuclear power plants. A physical walkdown of the Diesel Generator Buildings at WBN determined that the types of switches installed in the various process systems within this facility do not contain mercury. Limit switches containing free mercury were found to be installed in the General Electric supplied 6.9 kV switchgear of the fifth diesel generator, which was added at a later date. These switches, which consistute an exception to the general rule excluding free mercury, were evaluated and approved by TVA letter from F. W. Chandler, Chief Electrical Engineering Branch, to B. B. Sams, General Electric Co., 01/29/74. These limit switches serve as leveling aids in the circuit breaker elevating mechanism and are used during maintenance operations only. The ITE supplied switchgear for diesel generators 1A, 2A, 1B, and 2B do not utilize limit switches for this function.	a. None required.

Issues	Findings	Corrective Actions
Element 229.10 - BFN	BFN	BFN
a. Use of mercury switches in the Diesel Generator Building is a questionable practice.	a. TVA documentation indicates that the replacement of mercury switches in system 39 at BFN was initiated 12/70. Records indicating the completion of the replacement could not be located. Further, internal TVA documentation indicated that mercury switches were, as a general practice, to be avoided. TVA Design Standard DS-M18.1.2 restricts the use of switches containing free mercury and defines the policy for replacing existing components containing this element. Physical walkdowns of the Diesel Generator Buildings at BFN, along with review of vendor prints and commercial literature, established the existence of mercury-containing switches in the following systems: o Fuel oil system, system 18 o CO_2 storage, fire protection, and purge system, system 39 Documentation in accordance with DS-M18.1.2, to substantiate evaluation and approval of mercury switches in the above systems could not be established. Instruments of a different make and model with dry contacts are commercially available to perform equivalent functions. The walkdowns, review of vendor prints, and commercial literature further established the fact that process sensing switches in other diesel generator support systems at BFN do not contain free mercury.	a. The CAP transmitted by TCAB-481 dated 08/03/87 responds to Corrective Action Tracking document 229 10 BFN 01. The CAP notes that an evaluation of all mercury components will be performed to document justification for continued use of the component or replace the component per Mechanical Design Standard DS M18.1.2. This will ensure that mercury switches/components are evaluated for acceptance or replacement. (CATD 229 10 BFN 01)

Issues	Findings	Corrective Actions
Element 229.10 - BLN	BLN	BLN
a. Use of mercury switches in the Diesel Generator Building is a questionable practice.	a. Internal TVA documentation indicated that mercury switches were, as a general practice, to be avoided. TVA Design Standard DS-M18.1.2 restricts the use of switches containing free mercury and defines the policy for replacing existing components containing this element. Physical walkdowns of the Diesel Generator Buildings at BLN, along with review of vendor prints and commercial literature, established the absence of mercury-containing switches in this facility.	a. None required.
****************** Element 229.11 - Radiation Monitoring ******************		
SQN	SQN	SQN
a. Quantity of radiation detection equipment in the plant is deficient.	a. The SQN RMS has sufficient detection and sampling capability to meet the requirements of 10 CFR 20, 10 CFR 50 (including both Appendix A and Appendix I), Regulatory Guides 1.21, 8.8, 8.10, NUREG 0737 and NUREG 0737, Supplement 1. The SQN RMS compares favorably with equivalent systems at other licensed and operating PWR's. The SQN RMS also adopts presently accepted industry practices in its design requirements.	a. None required.
b. Radiation monitoring system (RMS) for process piping RMS needs more radiation detection equipment.	b. The present process piping RMS, including ventilation systems, monitor all systems having a reasonable potential for radioactive inventory as well as all release paths. This is consistent with present licensing requirements for SQN and the NRC SER which remains valid even though it does not consider the improvements made since it was filed.	b. None required.

Issues	Findings	Corrective Actions
Element 229.11 - SQN (Continued)		
c. Shield building vent stack RMS does not have enough RMS equipment to meet current federal guidelines.	c. The Shield Building Vent Stack RMS has sufficient equipment to meet 10 CFR 20, 10 CFR 50 and Regulatory Guide 1.21 requirements. It has been modified and expanded to meet NUREG 0737 and NUREG 0737 Supplement 1 post-TMI requirements.	c. None required.
d. Peripheral finding.	d. The SQN FSAR has not been updated to accurately reflect the additions, modifications, and improvements made to the SQN RMS since TMI.	d. The corrective action plan indicates that the post-TMI additional monitoring requirements, presently in the design drawings and the SQN RMS Design Criteria, will be added to the SQN FSAR in the next annual revision. (CATD 229 11 SQN 01)
e. Peripheral finding.	e. TVA Design Criteria SQN-DC-V-9.0, incorrectly states that the condenser vacuum pump exhaust vent monitor is provided to meet Regulatory Guide 1.45 requirements.	e. The revision to the TVA Design Criteria SQN-DC-V-9.0 Rev. 2 is for clarification only, and is not warranted at this time. (CATD 229 11 SQN 02)
WBN	WBN	WBN
a. There is not enough radiation detection equipment in the plant to meet current federal regulations or guidelines. Radiation monitors provided for process piping and the shield building vent stack are examples.	a. The WBN Radiation Monitoring System (RMS) has sufficient detection equipment to meet the quantitative requirements of 10CFR20, and 10CFR50 (including both Appendix A and Appendix I), and Regulatory Guides 1.21, 1.97, 8.8, and 8.10. This overall finding is supported by the following more specific findings: o WBN is similar in design to SQN. In a recently completed evaluation of the subject concern for SQN (Element Report 229.11(d), Revision 2, 01/08/87), it was concluded that the concern is not valid for SQN. o A detailed comparison of the RMS design criteria and licensing documents for WBN and for SQN shows that a number of differences exists between the radiation monitoring equipment provided for the two plants. However, a comparison of current as-built drawings and instrument lists for WBN and SQN shows that the RMSs for the two plants are essentially the same with one exception; viz., eight (8) main steamline radiation monitors which satisfy the requirements of Regulatory Guide 1.97 have been installed for WBN but not for SQN. (TVA has committed to install main steamline radiation monitors at SQN.)	a. None required.

Issues	Findings	Corrective Actions
Element 229.11 - WBN (Continued)		
	o In a TVA letter to the NRC dated January 30, 1984, TVA committed to install redundant high-range radiation monitors in the WBN containment, in both upper and lower compartments, by fuel loading. Current as-built drawings and instrument lists show that these monitors have been installed; however, their installation is not reflected in the current version of the WBN FSAR. With the installation of these monitors, WBN satisfies all of the quantitative post-accident radiation monitoring requirements of Regulatory Guide 1.97, Revision 3.	
b. Peripheral finding.	b. In addition, during the evaluation, the evaluation team found that a number of inconsistencies exists within WBN design documents and between these documents and the WBN FSAR. Some examples follow: o The latest version of the WBN RMS design criteria (WB-DC-40-24, R0) does not agree in many instances with Chapter 11 of the WBN FSAR. The two shield building vent monitors identified in the design criteria are replaced in the FSAR by four monitors. Also, the FSAR has identified main control room air intake monitors that are not mentioned in the RMS design criteria. o Some of the radiation monitoring requirements contained in the most recent version of the WBN design criteria for post-accident monitoring (PAM) (WB-DC-30-7, R1) do not agree with the WBN RMS design criteria (WB-DC-40-24, R0) or Chapter 11 of the WBN FSAR. For example, the accident range monitors specified by WB-DC-30-7 for the upper and lower compartments of the containment building are not included in WB-DC-40-24, nor are they identified in the FSAR even though they have been committed to the NRC and are currently installed.	b. CATD 22911 WBN 01 states that a number of inconsistencies concerning the RMS exist within WBN design documents and between these documents and the WBN FSAR. TVA's corrective action plan (TCAB 285, 03/12/87) commits to eliminate these inconsistencies by revising or appropriately modifying these documents and the FSAR before initial fuel load at the plant. This action is satisfactory to the evaluation team. (CATD 229 11 WBN 01)

Issues	Findings	Corrective Actions
Element 229.11 - WBN (Continued)		
	o On the basis of the WBN as-built drawings and instrument lists, monitors have been installed at the plant that are not identified by the WBN design criteria nor identified in the FSAR. Examples are a reactor coolant drain tank discharge monitor; a containment building floor and equipment drain discharge monitor; monitors for the residual heat removal lines; and a monitor at the personnel hatch outside containment. None of these monitors are provided to satisfy specific regulatory requirements and, thus, they provide WBN with radiation monitoring capability beyond that required for licensing purposes.	
BFN	BFN	BFN
a. There is not enough radiation detection equipment in the plant to meet current federal regulations or guidelines.	a. The BFN radiation monitoring system has sufficient detection equipment to meet the quantitative requirements of 10 CFR 20, 10 CFR 50 (including both Appendix A and Appendix I), and Regulatory Guides 1.21, 8.8, and 8.10. In addition, TVA has committed to install and make operational, before the next cycle startup of each unit, systems to satisfy the postaccident radiation monitoring requirements of NUREG-0737 and specific guidelines of Regulatory Guide 1.97. These systems are a high-range noble gas and iodine effluent monitoring system and a high-range redundant in-containment monitoring system.	a. CATD 229 11 BFN 01 states that the installation and checkout of post-accident radiation monitoring systems for in-containment monitoring and for noble gas and iodine effluent monitoring are incomplete. TVA's corrective action plan (ICAB-431, 07/14/87) commits to completion of these items in accordance with the committed schedule in the BFN Nuclear Performance Plan. (CATD 229 11 BFN 01)
b. Peripheral finding.	b. TVA has stated to the NRC a number of exceptions to the postaccident radiation monitoring guidelines of Regulatory Guide 1.97. The NRC has not responded formally to TVA's stated positions. Thus, there is still an open question concerning the acceptability of TVA's planned implementation of postaccident radiation monitoring at BFN.	b. CATD 229 11 BFN 02 states that TVA has not obtained formal agreement by the NRC to TVA's stated exceptions to Regulatory Guide 1.97 for BFN. TVA will track this open licensing issue until resolved with the NRC. (CATD 229 11 BFN 02)

Issues	Findings	Corrective Actions
Element 229.11 - BLN	BLN	BLN
a. There is not enough radiation detection equipment in the plant to meet current federal regulations or guidelines. Radiation monitors provided for process piping and the shield building vent stack are examples.	a. The BLN RMS has sufficient detection and sampling capability to meet the requirements of 10 CFR 20, 10 CFR 50 (including both Appendix A and Appendix I), Regulatory Guides 1.21, 8.8, 8.10, NUREG-0737 and NUREG-0737, Supplement 1. The BLN RMS compares favorably with equivalent systems at other licensed and operating PWRs. The BLN RMS also adopts presently accepted industry practices in its design requirements. The present process piping RMS, including ventilation systems, monitor all systems having a reasonable potential for radioactive inventory as well as all release paths. This is consistent with present licensing requirements for BLN and the AEC SER which remains valid even though it does not consider the improvements made since it was filed. The station vent stack RMS has sufficient equipment to meet 10 CFR 20, 10 CFR 50, and Regulatory Guide 1.21 requirements and meets the NUREG-0737 and NUREG-0737, Supplement 1 post-TMI requirements.	a. None required.
b. Peripheral finding.	b. The BLN FSAR and the design criteria have not been updated to accurately reflect the additions, modifications, and improvements made to the BLN RMS since TMI.	b. CATD 229 11 BLN 01 states that inconsistencies exist between BLN RMS design criteria, BLN general design criteria for postaccident monitoring and support instrumentation, BLN FSAR Sections 11.5 and 12.3.4, and design drawings for RMS. TVA's corrective action plan in TCAB-609 commits to revise RMS design criteria N4-1R-D740, R3 and postaccident monitoring general design criteria N4-50-D797, R2 as appropriate to remove inconsistencies. Additionally, FSAR Sections 11.5 and 12.3.4 and design input/output, including design drawings 2GW0900-1R-7, R12 and -4, R6 will be revised to reflect the appropriate design as specified in the revised criteria before fuel loading of BLN units 1 and 2. This action is satisfactory to the evaluation team. (CATD 229 11 BLN 01)

Issues	Findings	Corrective Actions
Element 229.11 - BLN (Continued)		
		CATD 229 11 BLN 02 states that BLN RMS design criteria neither identifies or describes postaccident monitors, nor their compliance with Tables II.F.1-1, II.F.1-2, and II.F.1-3 of NUREG-0737. TVA's corrective action plan TCAB-609 commits to revise RMS design criteria N4-IR-D740, R3 to identify postaccident monitoring requirements, and any other requirements imposed by TVA's post-TMI commitments before fuel loading of BLN units 1 and 2. This action is satisfactory to the evaluation team. (CATD 229 11 BLN 02)
		CATD 229 11 BLN 03 states that BLN FSAR Section 9.4 does not describe the BLN Service Building HVAC system. TVA's corrective action plan TCAB-609 commits to revising FSAR Section 9.4, along with Section 12.3.4, to resolve any inconsistencies and incorporate the corrections in the revised BLN RMS design criteria before fuel loading of BLN units 1 and 2. This action is satisfactory to the evaluation team. (CATD 229 11 BLN 03)

Issues	Findings	Corrective Actions

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Element 229.12 - Panel Instrument Distance
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Issues	Findings	Corrective Actions
SQN	**SQN**	**SQN**
a. Distances between control panels and controlled equipment are too long.	a. TVA's instrument and control configuration is consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or safe, efficient operation of equipment because of remoteness could be established.	a. None required.
b. Distances between instrument racks/panels and sensors are too long.	b. No adverse effects on response time with properly installed long liquid-sensing (impulse) lines could be established.	b. None required.
c. Possible noncompliance with FSAR commitments or NRC regulations.	c. No NRC, TVA, or industry regulation or standard could be found which limits the distance between equipment and control panels/instrument racks numerically. NRC requires periodic testing of controls and instrumentation, including response time, of protective systems. These tests have been performed and any deficiencies corrected.	c. None required.
WBN	**WBN**	**WBN**
a. Distances between control panels and controlled equipment are too long.	a. TVA's instrument and control configuration is consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or on safe, efficient operation of equipment because of remoteness could be established. TVA Policy Memorandum 86-02 requires that final calculations be prepared to establish technical design adequacy and to ensure compliance with the plant design basis.	a. None required.
b. Distances between instrument racks/panels and sensors are too long.	b. No adverse effects on response time with properly installed long liquid-sensing (impulse) lines could be established. The Field Walkdown and Verification Program required by TVA Engineering Requirements Specification No. ER-WBN-EEB-001, Section 3.1.2, ensures that sensing line lengths are minimized.	b. None required.

Issues	Findings	Corrective Actions
Element 229.12 - WBN (Continued)		
c. Possible noncompliance with FSAR commitments or NRC regulations.	c. No NRC, TVA, or industry regulation or standard could be found that limits the distance between equipment and control panels/instrument racks numerically. NRC requires periodic testing of controls and instrumentation, including response time, of protective systems. TVA has committed to a WBN testing program meeting the requirements of Regulatory Guide 1.22. Any response time deficiencies made evident by this program will be corrected before fuel load.	c. None required.
BFN	BFN	BFN
a. Distances between control panels and controlled equipment are too long.	a. TVA's instrument and control configuration is consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or safe, efficient operation of equipment because of remoteness could be established. TVA Policy Memorandum PM 86-02 requires that final calculations be prepared to establish technical design adequacy and to ensure compliance with the plant design basis.	a. None required.
b. Distances between instrument racks/panels and sensors are too long.	b. No adverse effects on response could be established for properly installed long liquid-sensing (impulse) lines.	b. None required.
c. There is possibly noncompliance with FSAR commitments or NRC regulations.	c. No NRC, TVA, or industry regulation or standard could be found which limits the distance between equipment and control panels/instrument racks to a finite value.	c. None required.

Issues	Findings	Corrective Actions
Element 229.12 - BLN	BLN	BLN
a. Distances between control panels and controlled equipment are too long.	a. TVA's instrument and control configuration is consistent with industry practice. For panels containing electrical controls and process parameter indications, no adverse effect on response time or on safe, efficient operation of equipment because of remoteness could be established. TVA Policy Memorandum 86-02 requires that final calculations be prepared to establish technical design adequacy and to ensure compliance with the plant design basis.	a. None required.
b. Distances between instrument racks/ panels and sensors are too long.	b. No adverse effects on response time with properly installed long liquid-sensing (impulse) lines could be established.	b. None required.
c. Possible noncompliance with FSAR commitments or NRC regulations.	c. No NRC, TVA, or industry regulation or standard could be found that limits the distance between equipment and control panels/instrument racks numerically. NRC requires periodic testing of controls and instrumentation, including response time, of protective systems. TVA has committed to a BLN testing program meeting the requirements of Regulatory Guide 1.22. Any response time deficiencies made evident by this program will be corrected before fuel load.	c. None required.

ATTACHMENT C

REFERENCES

1. NSRS Investigation Report I-85-525-WBN, covering the referenced concerns, [no RIMS number, TTB 6-3, Folder 38c], (12/17/85)

2. Bechtel IOM 1362 on TVA, SQN Generic Concern Task Force Investigation, "Employee Concerns IN-85-293-001, PH-85-022-001, NS-85-004-001," [no RIMS number], (06/06/86)

3. Principles and Practices of Flow Meter Engineering, L. K. Spink, The Foxboro Company, Ninth Edition, March 1978

4. Process Measurement: Instrument Engineers' Handbook, Chapter 2.12, "Orifice" and Chapter 2.23, "Venturi Tubes, Flow Nozzles and Flow Tubes," B. G. Liptak, Chilton Book Co., Revised Edition 1982

5. Fluid Meters, Their Theory and Application, edited by H. S. Bean, The American Society of Mechanical Engineers, Sixth Edition, 1971.
   - Part One, Theory and Mode of Operation, Chapter I-5, Differential Pressure Meters: Theory of Fluid Flow in Terms of Differential Pressures and Equations for Differential Pressure Meters
   - Part Two, Application of Fluid Meters - Especially Differential Pressure Types, Chapters II and III, Primary Elements and Equations for Computing Flow Rates

6. Performance Test Code PTC-6-1976, The American Society of Mechanical Engineers

7. Selecting the Right Flow Meter, Parts I and II, by D. H. Lomas, Kent Instrument Ltd., Instrumentation Technology, May, June 1977

8. TVA Electrical Design Standard DS-E18.1.10, R0, "Instrument Setpoints and Limits," [ESB 831213 203], (11/21/83)

9. TVA preliminary Electrical Design Standard DS-E18.3.6, "Documentation of Instrument Setpoints, Accuracies, and Limitations - Balance of Plant," [B42 860325 501], (03/21/86)

10. SQN Mechanical Instrument Tabulation, Drawing Series 47B601-XX (in effect on 11/04/86.)

11. SQN FSAR (through Amendment 3) Sections and related Flow Diagrams for the following systems:

9.2.1	Component Cooling System
9.2.2	Essential Raw Cooling Water
9.2.3	Demineralized Water Makeup System
9.2.7	Raw Cooling Water System

9.3.2 Process Sampling System
9.3.3 Equipment and Floor Drainage System
10.3 Main Steam Supply System
10.4.7.1 Condensate-Main Feedwater System
10.4.7.2 Auxiliary Feedwater System
10.4.9 Heater Drains and Vents
11.2 Liquid Waste Systems

12. SQN TVA Drawing Series 47W610:
-1-1, R18 Mechanical Control Diagram, Main Steam System
-1-2, R17 Mechanical Control Diagram, Main Steam System
-1-3, R20 Mechanical Control Diagram, Main Steam System
-1-4, R4 Mechanical Control Diagram, Main Steam System
-2-1, R15 Mechanical Control Diagram, Condensate System
-2-2, R15 Mechanical Control Diagram, Condensate System
-2-3, R16 Mechanical Control Diagram, Condensate System
-2-4, R6 Mechanical Control Diagram, Condensate System
-2-5, R5 Mechanical Control Diagram, Condensate System
-3-1, R18 Mechanical Control Diagram, Main & Auxiliary Feedwater Sys.
-3-2, R18 Mechanical Control Diagram, Main & Auxiliary Feedwater Sys.
-3-3, R15 Mechanical Control Diagram, Main & Auxiliary Feedwater Sys.
-6-1, R9 Mechanical Control Diagram, Heater Drains & Vents System
-6-2, R8 Mechanical Control Diagram, Heater Drains & Vents System
-6-3, R8 Mechanical Control Diagram, Heater Drains & Vents System
-6-4, R7 Mechanical Control Diagram, Heater Drains & Vents System
-6-5, R6 Mechanical Control Diagram, Heater Drains & Vents System
-59-1, R7 Mechanical Control Diagram, Demineralized Water & Cask Decontamination System
-67-1, R10 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-2, R11 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-3, R9 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-4, R14 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-5, R11 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-6, R8 Mechanical Control Diagram, Essential Raw Cooling Water System
-67-7, R1 Mechanical Control Diagram, Essential Raw Cooling Water System
-70-1, R13 Mechanical Control Diagram, Component Cooling Water System
-70-2, R16 Mechanical Control Diagram, Component Cooling Water System
-70-3, R14 Mechanical Control Diagram, Component Cooling Water System

13. SQN TVA Drawing Series 47W611:
-3-1, R6 Mechanical Logic Diagram, Feedwater Pump Turbine Auxiliaries
-3-2, R12 Mechanical Logic Diagram, Feedwater System
-3-3, R15 Mechanical Logic Diagram, Auxiliary Feedwater System
-3-4, R12 Mechanical Logic Diagram, Auxiliary Feedwater System
-3-5, R0 Mechanical Logic Diagram, Auxiliary Feedwater System
-70-1, R12 Mechanical Logic Diagram, Component Cooling System
-70-2, R9 Mechanical Logic Diagram, Component Cooling System
-70-3, R10 Mechanical Logic Diagram, Component Cooling System
-70-4, R3 Mechanical Logic Diagram, Component Cooling System

14. SQN TVA Drawing Series 47W803:
-2, R26 Flow Diagram, Auxiliary Feedwater
-3, R3 Flow Diagram, Auxiliary Feedwater

15. SQN TVA Drawing Series 47W859:
-1, R24 Flow Diagram, Component Cooling System
-2, R20 Flow Diagram, Component Cooling System
-3, R19 Flow Diagram, Component Cooling System
-4, R7 Flow Diagram, Component Cooling System
-5, R0 Flow Diagram, Component Cooling System

16. TVA Design Criteria SQN-DC-V:
-4.1.1, R0 Main Steam
-4.2, R1 Main Feedwater Makeup Water Treatment
-6.5.1, R0 Plant Demineralized Water
-7.4, R2 Essential Raw Cooling Water
-9.6.7, R1 Raw Cooling Water
-13.9.8, R0 Auxiliary Feedwater
-13.9.9, R0 Component Cooling Water
-22.0, R2 Liquid Radwaste Disposal

17. TVA Mechanical Design Guide DG:
-M2.1.1, R0 Main & Reheat Steam - Nuclear
-M2.2.1, R0 Main Feedwater System - Nuclear
-M2.3.1, R0 Condensate System
-M2.5.1, R0 Heater Drains & Vents - Nuclear
-M2.19.1, R0 Main Feed Pump Turbine System - Nuclear
-M5.2.3, R0 Orifices - Sizing & Applications
-M6.3.2, R0 Raw Cooling Water
-M6.3.3, R0 General Design of Essential Raw Cooling Water Systems
-M6.3.4, R0 Raw Cooling Water Systems for Nuclear Power Plants

18. NRC Regulatory Guide 1.97, "Instrumentation to Follow the Course of an Accident," R2, (12/80)

19. TVA Calculation SQN-SQS4-0066, "Final Type D Variable List for SQN," [B45 860829 218], (08/28/86)

20. Bechtel IOM 1327 from J. W. Hefler to D. L. Damon, "SQN Generic Employee Concern-Incorrectly Sized Orifice Plates," [no RIMS number], (12/02/86)

21. SQN TVA Demonstrated Accuracy Calculation 1,2-FT-3-142 Instrument Loop, [no RIMS number], (09/22/86)

22. Telephone Conference, D. L. Damon, Bechtel, with Marvin Belew, TVA, Error Factors in TVA Calculation FT-3-142, (12/01/86)

23. WBN Mechanical Instrument Tabulation, Drawing Series M47B601-XX, TTB-224 (in effect on 02/23/87)

24. WBN FSAR (through Amendment 55) Sections for the following systems:
    - 9.2.1 Essential Raw Cooling Water
    - 9.2.2 Component Cooling System
    - 9.2.3 Demineralized Water Makeup System
    - 9.2.8 Raw Cooling Water System
    - 10.3 Main Steam Supply System
    - 10.4.7 Condensate - Main Feedwater System
    - 10.4.9 Auxiliary Feedwater System
    - 10.4.10 Heater Drains and Vents

25. WBN TVA Control Diagram Drawing Series 47W610-X-X, TTB-226, (in effect on 02/23/87)

26. WBN TVA Drawing Series 47W611-X-X, TTB-226, (in effect on 02/23/87)

27. WBN TVA Flow Diagram Drawing Series 47W8X-X, TTB-213, (in effect on 02/23/87)

28. TVA Mechanical Design Guide DG:
    - -M2.1.1, RO, Main & Reheat Steam - Nuclear
    - -M2.2.1, RO, Main Feedwater System - Nuclear
    - -M2.3.1, RO, Condensate System
    - -M2.5.1, RO, Heater Drains & Vents - Nuclear
    - -M2.19.1, RO, Main Feed Pump Turbine System - Nuclear
    - -M5.2.3, RO, Orifices - Sizing & Applications
    - -M6.3.2, RO, Raw Cooling Water
    - -M6.3.3, RO, General Design of Essential Raw Cooling Water Systems
    - -M6.3.4, RO, Raw Cooling Water Systems for Nuclear Power Plants

29. Telephone conference, IOM 1348, J. Dodds, Bechtel, with Randall Johnson, TVA, WBN Loop Accuracy Calculations, (2/17/87)

30. BFN Mechanical Instrument Tabulation, Drawing Series 47B601-X-X, TTB-229

31. BFN FSAR Sections (through Amendment 4) and related flow diagrams, 47W8X-X, (in effect on 03/13/87) for the following systems:
    - 3.8 Standby Liquid Control System (SLC)
    - 4.7 Reactor Core Isolation Cooling System (RCIC)
    - 4.8 Residual Heat Removal System (RHR)
    - 4.9 Reactor Water Cleanup System (RWCU)
    - 4.11 Main Steam Lines, Feedwater Piping, and Drains
    - 6.4.1 High Pressure Coolant Injection System (HPCI)
    - 6.4.3 Core Spray System (CS)
    - 6.4.4 Low Pressure Coolant Injection System (LPCI)
    - 9.2 Liquid Radwaste System
    - 10.5 Fuel Pool Cooling and Cleanup
    - 10.6 Reactor Building Closed Cooling Water System
    - 10.7 Raw Cooling Water System
    - 10.8 Raw Service Water System
    - 10.9 RHR Service Water System
    - 10.10 Emergency Equipment Cooling Water System

10.16	Equipment and Floor Drainage Systems
11.5	Turbine Bypass System
11.6	Condenser Circulating Water System
11.7	Condensate Filter-Demineralizer System
11.8	Condensate and Reactor Feedwater Systems

32. BFN TVA Drawing Series 47W610-X; Mechanical Control Diagrams, TTB-234, (in effect on 03/13/87)

33. BFN TVA Drawing Series 47W611-X Mechanical Logic Diagrams, (in effect on 03/13/87)

34. TVA Mechanical Design Guide DG:

-M2.1.1, RO	Main and Reheat Steam - Nuclear
-M2.2.1, RO	Main Feedwater System - Nuclear
-M2.3.1, RO	Condensate System
-M2.5.1, RO	Heater Drains and Vents - Nuclear
-M2.19.1, RO	Main Feed Pump Turbine System - Nuclear
-M5.2.3, RO	Orifices - Sizing and Applications
-M6.3.2, RO	Raw Cooling Water
-M6.3.3, RO	General Design of Essential Raw Cooling Water Systems
-M6.3.4, RO	Raw Cooling Water Systems for Nuclear Power Plants

35. NUREG-0737, "Clarification of TMI Action Plan Requirements," November, 1980, Section II.F.1, "Additional Accident Monitoring Instrumentation"

36. Letter from L. M. Mills, TVA, to H. R. Denton, NRC, "Regulatory Guide 1.97 Requirements," [A27 840430 007], (04/30/84)

37. Vendor Contracts for BFN Flow Elements:

Contract	Vendor
821038	Meriam Inst. Co.
90744	GE
91750	GE
74869	GE
91185-2	GE
835179	GE
826697	Daniel Ind.
826498	Dieterick
827026	Ramapo
85590	Kinney Vacuum
85543	Dieterick
85916	Dieterick
91089	GE/BIF
85849-2	Dickey Inst.
84497-2	Unitech.
92272	Crane Inst.
820137-2	Dieterick
85116	Vickery Simms

38. Bechtel (TVA) Memo 1328, R. Tietz to J. Dodds, Baseline Evaluation, Attachment 1, Appendix A, BFNP Component Nameplate Data Sheet, "Walkdown Requests," from BFN Trailer 26, 1986, [no RIMS number]

39. Bechtel (TVA) memo 1326, R. Tietz to J. Dodds, "Element No. 229.1 - Search for Info," [no RIMS number], (04/04/87)

40. Bechtel (TVA) memo 1327, Powers, GE, to R. Tietz, Bechtel, "Manufacturing Data for GE Supplied Flow Elements," [no RIMS number], (04/08/87)

41. Telephone call, IOM 1349, from J. Dodds, Bechtel, to M. Gor and M. Kotarba, TVA, to discuss RFIs 1056, 1059, and 1060, (03/19/87).

42. TVA instrument and controls scaling and setpoint calculations for the following components, TTB 329-8, [no RIMS number], (04/09/87)
2PDT-1-50A, RO (05/27/87)
2PDT-71-1A, RO (04/14/86)
FS-73-33, RO (07/27/85)
FS-74-50, RO (02/19/86)
FS-75-80, RO (03/23/86)
FT-84-19, RO (03/18/86)

43. BLN Electrical Instrument Tabulation, Drawing Series 88 E5GBX900-XX, (in effect on 07/02/87)

44. BLN FSAR (through Amendment 27) Sections for the following systems:
9.2.1 Essential Raw Cooling Water
9.2.2 Component Cooling Water System
9.2.3 Demineralized Water Makeup System
9.2.7 Raw Cooling Water System
10.3 Main Steam System
10.4.7 Condensate and Feedwater System
10.4.9 Auxiliary Feedwater System
10.4.10 Heater Drains and Vents

45. BLN TVA Control Logic Diagram Drawing Series 88 E2GW0900-XX-XX, (in effect on 07/02/87)

46. BLN TVA Mechanical Design Criteria Drawing Series 88 M3AW08XX-XX-XX, (in effect on 07/02/87)

47. TVA Mechanical Design Guide DG:
-M2.1.1 RO Main & Reheat Steam - Nuclear
-M2.2.1 RO Main Feedwater System - Nuclear
-M2.3.1 RO Condensate System
-M2.5.1 RO Heater Drains & Vents - Nuclear
-M2.19.1 RO Main Feed Pump Turbine System - Nuclear
-M6.3.2 R1 Raw Cooling Water
-M6.3.3 RO General Design of Essential Raw Cooling Water Systems
-M6.3.4 RO Raw Cooling Water Systems for Nuclear Power Plants

48. Letter from Mills, TVA, to Adensam, NRC, "Response to Supplement 1 of NUREG-0737 Requirements," [A27 830415 013], (04/15/83)

49. TVA contract 77K3-822050-2 witn Daniel Measurement Co. [770920C0519], (08/25/77)

50. TVA contract 71C60-54114-2 with the Babcock and Wilcox Company (08/27/70)

51. IOM 1323, R. Reeves (TVA) to J. Dodds (Bechtel) B&W/Bailey Orifices, [no RIMS number], (06/24/87)

52. Telecon/IOM 1336, Dodds (Bechtel) to McMahon (Bailey Meter Co.) Orifices, (06/25/87)

53. TVA memo from Raughley to Distribution "Policy Memorandum PM86-02(EEB) - Electrical Calculations," [B43 860508 902], (05/08/86)

54. Request For Information (RFI) BLN-1557 (04/23/87)

55. Babcock and Wilcox Technical Document BWNP-20007, [no RIMS number], (06/76)

56. TVA contract 84KK7-833960 with Daniel Industries [MED 831012 515], (09/13/83)

57. TVA memo from J. A. Raulston to J. C. Key, "Sequoyah Nuclear Plant, Units 1 & 2 - Problem Identification Report (PIR) - PIRSQNNEB 8624 (B45 860926 851)," [B45 861002 264], (10/02/86)

58. TVA memo from J. A. Raulston to C. A. Chandley, "Nuclear Engineering Branch - Potential Generic Condition Evaluation for PIRWBNMEB 8658," [B45 860912 257], (09/12/86)

59. NSRS Investigation Report I-85-921-SQN, "Reactor Building Raceway Drains," (03/07/86)

60. Becntel memo, IOM 477, from E. A. Croft to D. L. Damon, "Walkdown Verification of Panel Drains, SQN Element 229.2," (11/18/86)

61. Bechtel memo, IOM 478, from E. A. Croft to D. L. Damon, "Walkdown Verification of Panel Drains, SQN Element 229.2," (11/19/86)

62. Bechtel memo, IOM 479, from E. A. Croft to D. L. Damon, "Walkdown Verification of Panel Drains, SQN Element 229.2," (11/20/86)

63. TVA, Watts Bar Nuclear Plant, Final Safety Analysis Report, through Amendment 57

64. TVA, SQN, and WBN Drawings: (in effect on 12/02/87)

47W476-1,	Annulus Floor Drains and Embedded Piping
47W476-2 through -8,	Containment Floor Drains and Embedded Piping.
47W478-1,	Embedded Piping, Base Slab
47W479-1 through -11,	Drains and Embedded Piping
47W600-Series	Instruments and Controls
47W625-1 through -22,	Radiation Sampling System
47W851-1,	Flow Diagram, Floor and Equipment Drains
47W852-1 through -4,	Flow Diagram, Floor and Equipment Drains

65. Trip Report, IOM 695, from B. D. Langtry, Bechtel, to D. L. Damon, Bechtel, [no RIMS number], (02/26/87)

66. Bechtel (TVA) memo 1577, R. Tietz to D. L. Damon, [no RIMS number], (07/25/87)

67. Bechtel (TVA) memo 1570, J. Dodds to R. Tietz, [no RIMS number], (07/28/87)

68. BLN Drawing 5AW0911-IO-21, R6, "Instrument and Controls, Typical Details and Installations," (09/08/81)

69. BLN Drawing 3GW0858-00-02, RO, "Flow Diagram, Station Drainage," (02/14/73)

70. BLN Drawings 3RW0463-00-01 through -07, "[Reactor Building] Drains and Embedded Piping" (in effect on 02/02/87)

71. BLN FSAR through Amendment 27

72. BLN Drawings 3AW0462-00-01 through -39, "[Auxiliary Building] Drains and Embedded Piping" (in effect on 09/02/87)

73. BLN Drawing 5AW-925-series, 5AW-926-series, 5AW-927-series, and 5RW-925-series, "Instruments and Controls, Local Panel[s]"

74. BWPC memo, IOM 1075, E. Croft to B. D. Langtry, "BLN Hot Instrument Panel Drains, Auxiliary Building, Elev. 590," [no RIMS number], (05/13/87)

75. BWPC memo, IOM 1051, E. Croft to B. D. Langtry, "BLN Hot Instrument Panel Drains [Auxiliary Building Elevations 610, 622, 629]," [no RIMS number], (05/19/87)

76. BWPC memo, IOM 1052, E. Croft to B. D. Langtry, "BLN Hot Instrument Panel Drains [Auxiliary Building Elevations 646, 647, 649, 667]," [no RIMS number], (05/20/87)

77. BWPC memo, IOM 1054, E. Croft to B. D. Langtry, "BLN Panel Drains, Element 229.2, [Reactor Building - Part II]," [no RIMS number], (05/21/8

78. BWPC memo, IOM 1078, E. Croft to B. D. Langtry, "BLN Hot Instrument Panel Drains [Auxiliary Building - Elevation 568, 583]," [no RIMS number], (06/01/87)

79. BLN Drawing 5GW0941-YQ-24, R9, "Instruments and Controls 1 & 2IX-IXPA-008 and 009, Installation - El. 610.0," (12/05/85)

80. BLN Drawing 5GW0941-YQ-26, R8, "Instruments and Controls, OIX-IXPA-004 and OIX-IXPA-005, Installation - El. 610.0," (09/16/85)

81. BLN Drawing 5GW0941-YQ-21, R7, "Instruments and Controls, Grab Sample Stations, Tabulation," (06/24/85)

82. BWPC memo, IOM 1050, E. Croft to B. D. Langtry, "BLN Sample Sinks at Elev. 590'," [no RIMS number], (05/13/87)

83. BFN Drawing Series: (in effect on 04/01/87)
47W448, "Sampling and Water Quality Systems"
47W475, "Embedded Piping"
47W476, "Embedded Piping"
47W479, "Embedded Piping"
47W600, "Instrumentation and Controls"

84. U.S. Environmental Protection Agency, Region IV, letter to TVA re: Public Notice of NPDES Permit Issuance, Watts Bar Nuclear Plant, NPDES TN0020168, [DES 840625 028], (06/18/84)

85. WBN FSAR Section 10.4.5.5, page 10.4-16a and page 10.4-14, first paragraph, Amendment 55

86. WBN drawings 47W831-1, R12 (FSAR Figure 10.4-2) and R18; 47W610-27-2, R2

87. Failure Evaluations/Engineering Reports on NCRs [B45 850717 258], (07/12/85 & 07/17/85)

88. TVA memo, J. W. Coan to G. Wadewitz, re: Watts Bar Nuclear Plant - Nonconforming Condition Report (NCR) W-250-P R0, [B26 850802 045 and 850087C0446], (08/02/85)

89. WBN FCR NP-1165, [T14 860320 800], (03/19/86)

90. WBN Workplan F-NP-1165-1, R0-1, (05/21/86)

91. WBN ECN 6431, [B26 860815 500], (08/15/86)

92. NSRS Investigation Report Transmittal related to EC number IN-85-281-001 (07/08/85), attaching ERT Investigation Report for EC IN-85-281-001 (07/02/85)

93. Nonconforming Condition Report (NCR) W-251-P, RO, (07/01/85)

94. WBN drawings 17W303-2, R8; 17W303-3, R11; 17W303-4, R8; 17W303-5, RO

95. WBN 1 ECN 6455, [B26 860902 526], (09/02/86)

96. Dietrich Standard Corporation (Purchase Order 73C38-83520-2) Drawings 761 through 766

97. SQN Design Criteria SQN-DC-V-1.1.11, "Evaluating the Effects of Pipe Failure Outside Containment," R4, [ESB 840913 202], (09/12/84)

98. SQN Design Criteria SQN-DC-V-2.13, "Evaluating the Effects of Pipe Failure Inside Containment," R4, [ESB840913205], (09/04/84)

99. AEC generic letter to applicants et al., from J. F. O'Leary, concerning postulated piping failures outside containment, [no RIMS number], (07/12/73)

100. SQN FSAR Section 9.3.1, "Compressed Air System," Amendment 3

101. 10 CFR 50, "Licensing Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants"

102. SQN Design Criteria SQN-DC-V-2.16, "Single Failure Criteria for Fluid and Electrical Safety Related Systems," RO, [B05 860721 500], (07/14/86)

103. ANSI/ANS Standard 58.9-1981, "Single Failure Criteria for Light Water Reactor Safety-Related Fluid Systems"

104. TVA Calculation "Safety Evaluation on Inadequate Separation of High Energy Lines and Essential Air Headers Inside Containment," [NEB 810811 274], R1, (08/11/81)

105. TVA SCR SQNMEB86121, RO, T. M. Lafferty, (12/15/86)

106. TVA Calculation "ACA Header Pressure," [B44 861208 011], RO, (12/08/86)

107. CAP Closure for Element Report 229.05 SQN, [no RIMS number], (08/17/87)

108. IEEE Standard 279-1968, "Criteria for Protection Systems for Nuclear Power Generating Stations"

109. WBN FSAR Section 9.3.1, "Compressed Air System," Amendment 52

110. TVA Report CEB-77-39, "Evaluation of the Effects of Postulated Piping Failures Inside Containment and the Main Steam Valve Rooms for Watts Bar Units 1 and 2," R1, [B42 851008 516], (Updated to 07/01/83)

111. TVA Report CEB-77.55, "Evaluation of the Effects of Postulated Piping Failures Outside of Containment for Watts Bar Nuclear Plant Units 1 and 2," R1, [no RIMS number], (09/21/83)

112. RFI WBN-166, [no RIMS number], (01/26/87)

113. Telephone call from D. Drouhard and P. Baxter, TVA, to C. Aronson, Bechtel, (02/11/87)

114. BLN FSAR Section 9.3.1, "Compressed Air Systems," Amendment 23

115. Design Criteria N4-50-D720, "Evaluating the Effects of Pipe Failure Inside and Outside Containment," R6, [B42 860108 500], (11/15/85)

116. TVA Report CEB-77-10, "Evaluation of the Effects of Postulated Piping Failures Outside Containment for Bellefonte Units 1 and 2," R1, [B41 850930 001], (10/01/85)

117. TVA, Sequoyah Nuclear Plant, Final Safety Analysis Report, through Amendment 3

118. Bechtel memo, E. Croft to D. L. Damon, Report of SQN Walkdown, (12/18/86)

119. TVA, Watts Bar Nuclear Plant, Final Safety Analysis Report, through Amendment 57

120. Bechtel IOM 695, B. D. Langtry to D. L. Damon, Trip Report, [no RIMS number], (02/26/87)

121. TVA memo, W. S. Raughley to Those Listed, "Policy Memorandum PM86-02 (EEB) - Electrical Calculations," [B43 860508 902], (05/08/86)

122. TVA memo from Cottle to Thompson, "Response to Request for Investigation," [no RIMS number], (12/23/85)

123. TVA memo from Thompson to Ennis, "Request for Further Response," [no RIMS number], (01/03/86)

124. TVA Problem Identification Report PIR WBN EEB8671 R0, [B26 861117 042], (11/17/86)

125. NRC Regulatory Guide 1.133, "Loose Parts Detection Program for the Primary System of Light-Water-Cooled Reactors," Rev. 1

126. Watts Bar SER Supplement 3, page 4-1, paragraph 4.4.5, [no RIMS number]

127. TVA memo from W. T. Cottle to W. H. Thompson, "Response to Request Investigation/Evaluation," [no RIMS number], (03/06/86)

128. Westinghouse Electric Corp., PWR Plant Division, Exhibit E to Contract No. 68C31-91934, "Preliminary Balance of Plant Design Criteria of Nuclear Steam Supply System for TVA Sequoyah Nuclear Plant," (revised 12/68)

129. TVA General Design Guideline, "Mercury - Plant Usage," Mechanical Design Standard DS-M18.1.2, R0, (01/18/83)

130. TVA memo from R. H. Dunham, Chief Mechanical Engineer, "Sequoyah Nuclear Plant Units 1 and 2 - Mercury - Plant Usage," [no RIMS number], (01/06/71)

131. TVA memo from D. B. Weaver, Chief Mechanical Engineer, "Nuclear Plant - Mercury - Plant Usage," [no RIMS number], (05/21/73)

132. NRC Office of Inspection and Enforcement IE Bulletin 80-19, "Failures of Mercury-Wetted Matrix Relays in Reactor Protective Systems of Operating Nuclear Power Plants Designed by Combustion Engineering," (07/31/80) R1 (08/15/80)

133. SQN TVA Drawing 47W839-1 R9, "Diesel Generator Building - Flow Diagram - Diesel Starting Air System"

134. SQN TVA Drawing 47W610-18-1 R15, "Mechanical Control Diagram - Fuel Oil System"

135. SQN TVA Drawing 47W611-18-1 R4, "Mechanical Logic Diagram - Fuel Oil System"

136. SQN TVA Drawing 47W840-1 R17, "Flow Diagram - Fuel Oil, Atomizing Air and Steam"

137. SQN TVA Drawing 47W840-2 R0, "Mechanical Flow Diagram - Diesel Generator Fuel Oil"

138. SQN TVA Drawing 47W610-39-2 R10, "Mechanical Control Diagram - CO_2 STG, Fire Protection and Purge System"

139. SQN TVA Drawing 47W610-82-1 R4, "Mechanical Control Diagram - Diesel Starting Air System"

140. SQN TVA Drawing 47W610-26-6 R3, "Mechanical Control Diagram - Hi Pressure Fire Protection"

141. SQN TVA Drawing 47B601-0-Series, "Mechanical Instrument Tabulation" (Systems 18, 26, 39, 82), (in effect on 12/17/86)

142. WBN TVA Drawings:

47W839-1 R15,	"Flow Diagram - Diesel Starting Air System - Diesel Generator Building Units 1 and 2"
47W839-2 R4,	"Flow Diagram - Diesel Starting Air System - Additional Diesel Generator Building - Units 1 and 2"
47W840-1 R26,	"Flow Diagram - Fuel Oil, Atomizing Air and Steamyard, Powerhouse and Diesel Generator Building Units 1 and 2"
47W840-2 R5,	"Flow Diagram - Fuel Oil, Atomizing Air and Steam - Additional Diesel Generator Building Units 1 and 2"
47W843-2 R12,	"Flow Diagram - CO_2 Storage and Fire Protection - Diesel Generator Building"
47W850-10 R23,	"Flow Diagram - Fire Protection - Turbine, 5th Diesel Generator, Security Backup Power Buildings and Makeup Water Plant"
47W610-18-1 R15,	"Electrical Control Diagram - Fuel Oil System"
47W610-18-2 R6,	"Electrical Control Diagram - Fuel Oil System"
47W610-82-1 R6,	"Electrical Control Diagram - Diesel Starting Air System"
47W610-39-2 R7,	"Electrical Control Diagram - CO_2 Storage, Fire Protection and Purge System - Diesel Generator Building - Units 1 and 2"
47W610-26-6 R8,	"Electrical Control Diagram - Hi Pressure Fire Protection System - Control and Diesel Generator Buildings - Units 1 and 2"
47W610-26-9 R5,	"Electrical Control Diagram - Hi Pressure Fire Protection System - Additional Diesel Generator Building, Makeup Water Treatment Plant - Units 1 and 2"

143. WBN TVA Drawing 47B601-0 (R3) Series, "Mechanical Instrument Tabulation" (Systems 18, 26, 39, and 82), (in effect on 01/31/87)

144. BFN TVA Drawing 47W610-18-1 R8, "Mechanical Control Diagram - Fuel Oil System"

145. BFN TVA Drawing 47W610-18-2 R3, "Mechanical Control Diagram - Fuel Oil System"

146. BFN TVA Drawing 47W610-26-11 R2, "Mechanical Control Diagram - Hi Pressure Fire Protection System"

147. BFN TVA Drawing 47W610-39-1 R15, "Mechanical Control Diagram CO_2 Storage, Fire Protection, and Purge System"

148. BFN TVA Drawing 47W610-39-2 R6, "Mechanical Control Diagram CO_2 Storage, Fire Protection, and Purge System"

149. BFN TVA Drawing 47W610-67-1 R19, "Mechanical Control Diagram - Emergency Equipment Cooling Water System"

150. BFN TVA Drawing 47W601-67-2 R16, "Mechanical Control Diagram - Emergency Equipment Cooling Water System"

151. BFN TVA Drawing 47B601-0-Series, "Mechanical Instrument Tabulation" (Systems 18, 26, 39, and 67), (in effect on 04/06/87)

152. TVA BLN Drawings

3GW0653-KE-1, R16	"Essential Raw Cooling Water Design Criteria Diagram, Powerhouse Units 1 and 2"
3GW0653-KE-6, R9,	"Essential Raw Cooling Water Design Criteria Diagram, Powerhouse Units 1 and 2"
3GW0853-KE-3, R0	"Essential Raw Cooling Water, Powerhouse Operating Diagram"
3GW0853-KE-13, R0	"Essential Raw Cooling Water, Powerhouse Operating Diagram"
2GW0900-KE-3, R11	"Functional Control Logic Diagram Essential Raw Cooling Water System, Powerhouse Units 1 and 2"
2GW0900-KE-5, R10	"Functional Control Logic Diagram Essential Raw Cooling Water System, Powerhouse Units 1 and 2"
2GW0900-KE-6, R8	"Functional Control Logic Diagram Essential Raw Cooling Water System, Powerhouse Units 1 and 2"
3DW0668-RF-1, R6	"Design Criteria Diagram High Pressure Fire Protection, Diesel Generator Building Units 1 and 2"
3GW0668-00-1, R15	"Design Criteria Diagram High Pressure Fire Protection and Service Water, Units 1 and 2"
3GW0668-00-5, R7	"Design Criteria Diagram High Pressure Fire Protection and Service Water, Units 1 and 2"
3GW0868-RF-1, R0	"Key Diagram High Pressure Fire Protection System, Units 1 and 2"
2GW0900-RF-13, R3	"Functional Control Logic Diagram High Pressure Fire Protection System, General Units 1 and 2"
3GW0683-00-1, R11	"Design Criteria Diagram Fuel Oil System, Units 1 and 2"
3GW0683-00-2, R9	"Design Criteria Diagram Fuel Oil System, Units 1 and 2"
3GW0883-FF-1, R0	"Flow Diagram Fuel Oil System, Units 1 and 2"
2GW0900-FF-1, R5	"Functional Control Logic Diagram Fuel Oil System, Powerhouse Units 1 and 2"
2GW0900-FF-2, R6	"Functional Control Logic Diagram Fuel Oil System, Powerhouse Units 1 and 2"
3GW0684-GC-1, R9	"Design Criteria Diagram CO_2 Storage, Fire Protection and Purging System, Powerhouse Units 1 and 2"
3GW0684-GC-2, R9	"Design Criteria Diagram CO_2 Storage, Fire Protection and Purging System, Powerhouse Units 1 and 2"
3GW0884-GC-1, R1	"Flow Diagram CO_2 Storage, Fire Protection and Purging System, Units 1 and 2"

3DW0685-RG-1, R10 "Design Criteria Diagram Starting Air System, Diesel Generator Building Units 1 and 2"
3GW0669, RE-03, R6 "Design Criteria Diagram Demineralized Water System, Powerhouse Units 1 and 2"
3GW0670-RK-04, R9 "Compressed Air System, Units 1 and 2"

153. TVA BLN Instrument Tabulation 5GB1900 & 5GB2900 Series: (in effect on 09/01/87)
Fuel Oil System, System FF
Starting Air System, System RG
CO_2 Storage, Fire Protection and Purge System, System GC
Essential Raw Cooling Water System, System KE
High Pressure Fire Protection System, System RF
Standby Diesel Generator and Controls, System RT

154. Vendor drawings - Delaval Contract 76K61-86181.
09-500-75080, sh 6 and 9RN, "Control Panel Schematic"
09-688-75080, sh 1 and 2RH, "Engine and Skid Electrical Schematic"
09-695-75080, RO "Engine Pneumatic Schematic"
09-820-75080, RC "Lube Oil Piping Schematic"
09-827-75080, RC "Fuel Oil Piping Schematic"
09-835-75080, RG "Starting Air Piping Schematic"
52340, RO "Panel Pneumatic Schematic"
52342, RO "Engine Pneumatic Schematic"

155. 10 CFR 50, Domestic Licensing of Production and Utilization Facilities, Section 50.34a, "Design Objectives for Equipment To Control Release of Radioactive Materials in Effluents"

156. 10 CFR 50 Appendix A, General Design Criteria 60, "Control of Releases of Radioactive Materials to the Environment"

157. 10 CFR 50 Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage"

158. 10 CFR 50, Appendix A, General Design Criteria 64, "Monitoring Radioactivity Releases"

159. 10 CFR 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion, As Low As Reasonably Achievable," etc.

160. 10 CFR 20, "Standards for Protection Against Radiation"

161. NRC Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light Water Cooled Nuclear Power Plants," R1, (06/74)

162. NRC Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievable," R3, (06/78)

163. NRC Regulatory Guide 8.10, "Operating Philosophy for Maintaining Radiation Exposures As Low As Reasonably Achievable (Nuclear Power Reactors)," R1, (05/77)

164. Regulatory Guide 1.97, "Instrumentation to Follow the Course of an Accident," R2, (12/80)

165. SQN FSAR (through Amendment 3) Sections:
11.4, "Process and Effluent Radiological Monitoring and Sampling System"
12.1.4, "Area Monitoring"

166. TVA Detailed Design Criteria No. SQN-DC-V-9.0, "Sequoyah Nuclear Plant Radiation Monitoring System," R2 (07/14/86)

167. SQN TVA Drawing 45N690:
-1 R10 "Wiring Diagrams Radiation Monitoring System, Schematic Diagrams Sheet 1"
-2 R12 "Wiring Diagrams Radiation Monitoring System, Schematic Diagrams Sheet 2"
-3 R6 Wiring Diagrams Radiation Monitoring System, Schematic Diagrams Sheet 3"
-4 R1 "Wiring Diagrams Radiation Monitoring System, Schematic Diagrams Sheet 4"

168. SQN TVA Drawing Series 47A052, (in effect on 12/11/86)"Mechanical Seismic Supports - Radiation Monitoring and Sampling"

169. SQN TVA Drawing Series 47W600:
-100 R13, "Mechanical Instruments and Controls"
-101 R6, "Mechanical Instruments and Controls"
-102 R10, "Mechanical Instruments and Controls"
-103 R4, "Mechanical Instruments and Controls"
-104 R19, "Mechanical Instruments and Controls"
-105 R10, "Mechanical Instruments and Controls"
-106 R14, "Mechanical Instruments and Controls"
-107 R9, "Mechanical Instruments and Controls"
-108 R0, "Mechanical Instruments and Controls"
-109 R4, "Multiline Shield Building Seals"
-110 R3, "Mechanical Instruments and Controls, Pneu & Elec Test Bench"
-111 R3, "Mechanical Instruments and Controls, Pneu & Elec Test Bench Det"
-112 R1, "Mechanical Instruments and Controls, Pneu & Elec Test Bench Det"
-204 R3, "Mechanical Instruments and Controls"
-301 R4, "Mechanical Instruments and Controls"
-302 R2, "Mechanical Instruments and Controls"

170. SQN TVA Drawing Series 47W610:
-90-1 R19, "Mechanical-Control Diagram - Radiation Monitoring System"
-90-2 R22, "Mechanical-Control Diagram - Radiation Monitoring System"
-90-3 R13, "Mechanical-Control Diagram - Radiation Monitoring System"
-90-4 R26, "Mechanical-Control Diagram - Radiation Monitoring System"
-90-5 RO, "Mechanical-Control Diagram - Radiation Monitoring System"

171. SQN TVA Drawing Series 47W611:
-30-6 R16 "Mechanical Logic Diagram Ventilation System"
-77-1 R10 "Mechanical Logic Diagram Waste Disposal System"

172. SQN TVA Drawing Series 47W625:
-1 R22, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-2 R14, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-3 R11, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-4 R13, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-5 R14, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-6 R5, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-7 R13, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-8 R18, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-9 R8, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-10 R4, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"
-11 R10, "Mechanical-Radiation Sampling System - Auxiliary and Reactor Building"

173. SQN Safety Evaluation Report, (03/79), Supplement 1, (02/80), Supplement 2, (08/80)

174. NUREG-0737, Supplement 1, "Clarification of TMI Action Plan Requirements," November 1980, Section II.F.1, "Additional Accident Monitoring Instrumentation"

175. NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short Term Recommendation," (July 1979)

176. NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," (May 1980)

177. NUREG-0737, "Clarification of TMI Action Plan Requirements," (November 1980)

178. SQN FSAR (through Amendment 3) Section 11.4, "Process and Effluent Radiological Monitoring and Sampling System"

179. SQN FSAR (through Amendment 3) Section 12.1.4, "Area Monitoring"

180. TVA Contract J2-826848, "Isokinetic Stack, Sampling Station," Air Monitor Corporation (12/10/79)

181. TVA Change of Contract 72C61-92759, "Radiation Monitors," General Atomic Company (12/12/80)

182. TVA Purchase Requisition Number 829854, "Emergency Purchase - Effluent Radiation Monitors," (09/22/82)

183. TVA letter to General Atomic Company, "Contract 72C61-92759 - Sequoyah and Watts Bar Nuclear Plants - Radiation Monitors - PA letter No. 5," [EEB 810115 060], (01/14/81)

184. SQN TVA Drawing 47B601-90-0, R43, "Mechanical Instrument Tabulation"

185. NUREG-0737, Supplement 1, "Clarification of TMI Action Plan Requirements," (11/80), Section II.F.1, "Additional Accident Monitoring Instrumentation"

186. Letter from L. M. Mills, TVA, to E. Adensam, NRC, [A27 820315 096], (03/15/82)

187. Letter, J. O. Vantrease, Impell, to G. W. Painter, TVA, "Revision 1 to Proposal for Regulatory Guide 1.97, Rev. 2, Compliance Program," [no RIMS number], (10/13/86)

188. TVA OE Calculation SQN-SQS4-0052, "PAM Variable Determination in Accordance with Reg. Guide 1.97, R2 (Types A, B, & C) [B45 860731 218], (07/30/86)

189. Letter from L. M. Mills, TVA, to E. Adensam, NRC, [A27 830304 001] (03/14/83)

190. Letter from E. Adensam, NRC, to H. G. Parris, TVA, [A02 840620 001] (06/15/84)

191. Letter from R. L. Gridley, TVA, to B. Youngblood, NRC, [L44 860930 805], (09/30/86)

192. WBN FSAR Sections as amended through April 1985 (Amendment 56):
11.4 "Process and Effluent Radiological Monitoring and Sampling System"
12.3.4 "Area Radiation and Airborne Radioactivity Monitoring Instrumentation"
7.5 "Safety Related Display Instrumentation"

193. WBN SER Sections, NUREG-0847 (06/82):
7.5.2 "Postaccident Monitoring System"
11.5 "Process and Effluent Radiological Monitoring and Sampling System"
11.6 "Evaluation Findings"
11.7 "NUREG-0737 Items"
12.4 "Radiation Protection Design Features"
12.7 "NUREG-0737 Items"

194. TVA Detailed Design Criteria WB-DC-30-7, "Post-Accident Monitoring and Support Instrumentation," R1, (12/18/84)

195. TVA letter to NRC concerning "Compliance with Regulatory Guide 1.97," [no RIMS number], (01/30/84)

196. TVA OE Calculation SQN-SQS4-0068, "Type D & E Variables in Accordance with Reg. Guide 1.97, R2," [no RIMS number], (09/11/86)

197. WBN SER Supplement 4, Section 1.9, "License Conditions," [no RIMS number], (03/85)

198. WBN TVA Drawing 47W610-90, "Mechanical Control Diagram, Radiation Monitoring System," Sheets 1R9, 2R12, 3R12, 4R17, and 5R6

199. WBN TVA Drawing 47B601-90 series, R41, "Mechanical Instrument Tabulation"

200. Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," R3, (05/83)

201. WBN SER Supplement 1 (09/82), Supplement 2 (01/84), Supplement 3 (01/85)

202. General Electric Design and Analysis Report for BFN, Volume IX, "Plant Control and Instrumentation," (11/02/66)

203. TVA Design Criteria BFN-50-7090, "Radiation Monitoring System," Draft B, (01/27/87)

204. BFN FSAR (through Amendment 4) Section 7.12, "Process Radiation Monitoring" and Section 7.13, "Area Radiation Monitoring System"

205. BFN Instrument Tabulation for Radiation Monitoring System, Document 67-M-47B601-90-0, R29, (revised through 03/20/86)

206. BFN TVA Drawing 47W610-90, "Mechanical Control Diagram, Radiation Monitoring System," Sheets 1R28, 1RB, 2R17, 3R4, 4R5, 6R0, 7R0, 8R1, and 20R5

207. BFN SER Supplement 1 Supporting the Operation After the Restoration and Modification of the Browns Ferry Nuclear Plant, Units 1 and 2, following the March 22, 1975 Fire, (06/76)

208. 10 CFR 50, Appendix A, General Design Criterion 13, "Instrumentation and Control"

209. Letter from L. M. Mills, TVA, to E. G. Eisenhut, NRC, "BFN Response to NUREG 0578," [DES 791022 019], (10/17/79)

210. Letter to NRC concerning "Compliance with Regulatory Guide 1.97 for BFNP," [no RIMS number], (04/30/84)

211. Letter from L. M. Mills, TVA, to H. R. Denton, NRC, "Deviations from NUREG-0737 Items II.E.4.1.2, II.F.1.1 and II.F.1.2," [A27 820125 035], (01/25/82)

212. Letter from D. B. Vassallo, NRC, to H. B. Parris, TVA, "Emergency Response Capability - Conformance to R. G. 1.97, Rev. 2," [A02 850128 008], (01/23/85)

213. Letter from J. A. Domer, TVA, to D. B. Vassallo, NRC, concerning RG 1.97, R2, [E44 850507 800], (05/07/85)

214. Conference between E. Croft, Bechtel, and E. Holder, BFN-TVA, (03/19/87)

215. Phone conference between R. D. Tietz, Bechtel, and Don Ricketts, Instrument Maintenance BFN-TVA, (03/26/87)

216. Letter from D. B. Vassallo, NRC, to H. G. Parris, TVA, "Modification of Order to Extend Schedule on NUREG-0737, Item II.F.1.3 for BFNP, Unit 3," [no RIMS number], (03/24/84)

217. Conference between E. Croft, Bechtel, and T. Carpenter, BFN-TVA, (03/19/87)

218. BLN FSAR sections as amended through 06/20/86 (Amendment 27):
3.8.4.1.1 "Secondary Containment Structure"
7.5 "Safety Related Display Instrumentation"
9.4 "Air Conditioning, Heating, Cooling, and Ventilation Systems"
10.4.6 "Condensate Demineralizer System".
11.2 "Liquid Waste Disposal System"
11.3 "Gaseous Waste Disposal System"
11.5 "Process and Effluent Radioactivity Monitoring and Sampling System"
12.3.2.4.4 "Turbine Building and Service Building"
12.3.4 "Continuous Air Monitoring System and Area Radiation Monitoring System"

219. BLN TVA Drawings, "Functional Control Logic Diagram, Radiation Monitoring System":
2GW0900-IR-1, R7, (01/15/85)
2GW0900-IR-2, R8, (01/15/85)
2GW0900-IR-3, R7, (07/23/84)
2GW0900-IR-4, R6, (09/09/85)
2GW0900-IR-7, R12, (09/09/85)

220. TVA Design Criteria N4-IR-D740, "Detailed Design Criteria for Radiation Monitoring System," R3, (03/10/86)

221. TVA General Design Criteria N4-50-D797, "Post-Accident Monitoring and Support Instrumentation," R2, (04/01/85)

222. BLN SER U.S. AEC (05/24/74) Sections:
11.5 "Process and Effluent Radiological Monitoring Systems"
12.1 "Shielding and Health Physics Program"

223. TVA Transmittal 408.6

224. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Sections 11.5 and 12.3-12.4, (06/86)

225. BLN TVA FSAR Figures/Design Criteria Diagrams 1.2.3-1B "Main Plant Location of Structures":
9.2.1.-1/3GW0653-KE-01-R16, "Powerhouse Units 1 & 2 Essential Raw Cooling Water," (10/16/86)
9.3.3-3/3GW0658-WE-01-R6, "Turbine Bldg. - Units 1 & 2 Station Drainage," (11/27/84)
9.3.4-2/3AW0678-NB-02-R9, "Aux. Bldg. Units 1 & 2 Chemical Addition and Boron Recovery System," (05/27/86)
9.3.4-3/AW0678-NB-03-R9, "Aux. Bldg. Units 1 & 2 Chemical Addition and Boron Recovery System," (01/25/85)
9.4.1-2/3CW0647-00-02-R11, "Control Bldg., Units 1 & 2 Heating, Ventilating, and Air Cond. System Air Flow," (12/12/83)
9.4.2-01/3AW0642-VB-01-R5, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (08/01/84)
9.4.2-01(A)/3AW0642-VB-02-R7, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (10/27/85)
9.4.2-02/3AW0642-VB-03-R8, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (10/29/83)
9.4.3-1/3AW0642-VC-01-R3, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System (10/29/83)
9.4.3-2/3AW0642-VC-02-R6, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (02/06/85)
9.4.3-3/3AW0642-VC-03-R5, "Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (10/29/83)

9.4.4-1/3TW0645-VT-01-R10,	"Turbine Bldg. Units 1 & 2 Ventilation and Air Cond. System," (07/25/85)
9.4.5-01/3AW0642-VA-01-R6,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (01/25/83)
9.4.5-02/3AW0642-VA-02-R6,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (01/25/83)
9.4.5-03/3AW0642-VA-03-R4,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (10/27/83)
9.4.5-04/3AW0642-VA-04-R6,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (03/31/86)
9.4.5-05/3AW0642-VA-05-R4,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (08/05/85)
9.4.5-07/3AW0642-VA-07-R4,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (01/25/83)
9.4.5-08/3AW0642-VA-08-R8,	"Aux. Bldg. Units 1 & 2 Heating and Ventilation System," (10/14/86)
9.4.8-1/3RW0641-00-01-R16,	"Reactor Bldg. Units 1 & 2 Ventilation, Purge & Cooling Systems," (09/23/85)
10.4.6-3/3BW0611-CN-03-R9,	"Turbine Bldg. Units 1 & 2 Condensate Demineralizer," (04/28/86)
11.0.0-1/3BW0680-WO-01-R14,	"Waste Disposal System," (08/21/85)
11.0.0-2/3BW0680-WO-02-R17,	"Waste Disposal System," (10/09/85)
11.0.0-4/3BW0680-WO-04-R10,	"Waste Disposal System," (10/18/84)
11.0.0-5/3BW0680-WO-05-R11,	"Waste Disposal System," (01/24/85)
11.0.0-6/3BW0680-WO-06-R11,	"Waste Disposal System," (10/09/85)
11.0.0-8/3BW0680-WO-08-R7,	"Waste Disposal System," (08/15/84)
11.0.0-10/3BW0680-WO-07-R10,	"Waste Disposal System," (10/09/85)
None/3BW0609-WM-01-R0,	"Powerhouse Hot Shop & Decon. Facility Water Collection & Discharge System," (04/04/85)

226. TVA Electrical Design Guide DG-E1.1.3, R0, "Clearance Around Electrical and Instrumentation and Control Equipment," (03/29/84)

227. Updated SQN FSAR Section 7.0, Instrumentation and Controls, (04/14/83), through Amendment 3, (04/86)

228. TVA Electrical Design Guide DG-E18.1.12, R0, "Human Factors Engineering in Control Console, Cabinet, and Panel Layout," (04/30/82)

229. TVA Electrical Design Guide DG-E18.1.13, R0, "Human Factors Engineering in Alarm Systems," (07/16/82)

230. TVA Electrical Design Guide DG-E18.1.14, R0, "Human Factors Engineering in Controls and Visual Displays," (04/30/82)

231. NRC Report NUREG-0700, "Guidelines for Control Room Design Review," (08/81)

232. NRC Report NUREG-0737, "Clarification of TMI Action Plan Requirements" (11/80) and Supplement, (01/83)

233. TVA ECSP, Subcategory Report 20800, R3, "Human Factors" (10/16/87)

234. 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants," (02/10/71)

235. NRC Regulatory Guide 1.22, "Periodic Testing of Protection Systems Actuation Functions," (02/17/72)

236. Institute of Electrical and Electronics Engineers (IEEE) Std 338-1977, "Standard Criteria for the Periodic Testing of Nuclear Generating Station Safety Systems"

237. Nuclear Power Plant Experience Inc. Reports, published by The S. M. Stoller Corporation, up to October 1986 for SQN-01

238. WBN FSAR Section 7.0, Instrumentation and Controls, (10/04/76), through Amendment 59, (08/28/86)

239. San Onofre Nuclear Generating Station Units 2 and 3, FSAR Section 11.5, Table 11.5-3, (Amendment 21)

240. TVA ECSP Report 17300, R0, (12/23/86)

241. BFN FSAR Section 7.0, "Instrumentation and Controls," (09/25/70), through Amendment 4, (09/86)

242. TVA Engineering Requirements Specification ER-WBN-EEB-001 R1, "Instrument and Instrument Line Installation and Inspection," [826 870128 447], (02/03/87)

243. Nuclear Plant Operating Experience Inc. Reports, published by The S. M. Stoller Corporation, up to October 1986 for BFN-01, 02, and 03

244. BLN FSAR Section 7.0, "Instrumentation and Controls," (06/78), through Amendment 27, (08/86)

245. TVA SQN Drawings: (in effect on 12/02/86)

47W476-1	Annulus Floor Drains and Embedded Piping
47W476-2 through -8	Containment Floor Drains and Embedded Piping
47W478-1	Embedded Piping Base Slab
47W479-1 through -11	Drains and Embedded Piping
47W560-21	Waste Disposal System
47W600-Series	Instruments and Controls
47W625-1 through -22	Radiation Sampling System
47W851-1	Flow Diagram Floor and Equipment Drains
47W852-1 through -4	Flow Diagram, Floor and Equipment Drains

246. WBN Design Criteria WB-DC-40-31.50, "Evaluating the Effects of a Pipe Failure Inside and Outside Containment," R4, [B42 851008 516], (09/19/85)

247. BLN System Description for Compressed Air System N4-RK-4002, R0, [B42 850516 502], (04/26/85

248. BLN Design Criteria N4-RJ-D740, "Essential Compressed Air System," R3, [B42 860130 506], (01/14/86)

249. Bechtel (TVA) memo IOM 0582D, E. Croft to D. L. Damon, "Shutdown Board Room Compression Tank Level Control," (11/25/86)

250. TVA WBN Drawings

47W611-31-7, R8, "Ventilation System, Electrical Logic Diagram"
47W865-5, R14, "Air Conditioning Chilled Water"
47W920-21, R12, "Auxiliary Building Units 1 and 2, Mechanical Heating, Ventilating and Air Conditioning"

251. TVA WBN Drawings

47W865-3, R19, "Flow Diagram - Air Conditioning Chilled Water - Powerhouse Control Building"
47W865-7, R17, "Flow Diagram - Air Conditioning Chilled Water - Powerhouse Control Building"
47W865-8, R19, "Flow Diagram - Air Conditioning Chilled Water - Powerhouse Auxiliary Building Units 1 & 2"

252. Telephone call from D. Knudsen, Bechtel-SQN, to G. Andrejeff, Bechtel, (12/17/86) "Operation of Chilled Water System Compression Tank Level Switch"

253. TVA Specification 3629, "Vibration and Loose Parts Monitoring System," undated

254. Standardized Nuclear Unit Power Plant Systems (SNUPPS), FSAR Section 11.5, Table 11.5-4 (Revision 15)

255. Palo Verde Nuclear Generating Station, Units 1, 2, and 3, FSAR Section 11.5, Table 11.5-1 (Amendment 12)

256. Daniel Industies, Inc., calculation no. 83-345C, [no RIMS number], (undated)

257. General Electric Specification 21A1058 R4, [no RIMS number], (11/12/68)

258. General Electric Specification 21A1379AJ R3, [no RIMS number], (05/15/69)

259. General Electric Specification 21A1294 RO, [no RIMS number], (03/07/68)

260. Letter from F. W. Chandler, TVA, to B. B. Sams, General Electric, "Watts Bar Nuclear Plant Units 1 and 2, 6900-Volt Auxiliary Power Switchboards Contract 74C-84376 - Mercury Switches," [no RIMS number], (01/29/74)

261. IOM 1344 Reeves, TVA, to Dodds, Bechtel, "BFN TVA Demonstrated Accuracy Calculation FS-73-33 Instrument Loop, "Preliminary Draft, [no RIMS number], (03/16/87)

262. Telephone call from S. Thorne, TVA-BFN, to L. Damon, Bechtel, "BFN Testing to Regulatory Guide 1.22," (12/28/87)

ATTACHMENT D

TABLES

Attachment D -- lists in tabular form specific information relevant to certain elements. These tables are referred to in the text of Section 4, but their inclusion there would seriously undermine readability. Exceptions are Tables 1 and 2, which do appear in the text.

TABLE 3

SQN ORIFICE PLATES

Element No.	System	Application
FE-6-107	Heater Drains & Vents	Alarm
FE-6-205	Heater Drains & Vents	Alarm
FE-6-231	Heater Drains & Vents	Alarm
FE-6-233	Heater Drains & Vents	Alarm
FE-6-244	Heater Drains & Vents	Alarm
FE-6-246	Heater Drains & Vents	Alarm
FE-6-256	Heater Drains & Vents	Alarm
FE-6-258	Heater Drains & Vents	Alarm
FE-24-26	Raw Cooling Water	Alarm
FE-24-33	Raw Cooling Water	Alarm
FE-24-39	Raw Cooling Water	Alarm
FE-24-46	Heater Drains & Vents	Alarm
FE-24-59	Raw Cooling Water	Alarm
FE-24-64	Raw Cooling Water	Alarm
FE-67-61	Essential Raw Cooling Water	Alarm
FE-67-62	Essential Raw Cooling Water	Alarm
FE-67-69	Essential Raw Cooling Water	Alarm
FE-67-74	Essential Raw Cooling Water	Alarm
FE-67-122	Essential Raw Cooling Water	Alarm
FE-67-136	Essential Raw Cooling Water	Alarm
FE-67-159	Essential Raw Cooling Water	Alarm
FE-67-163	Essential Raw Cooling Water	Alarm
FE-67-165	Essential Raw Cooling Water	Alarm
FE-67-169	Essential Raw Cooling Water	Alarm
FE-67-171	Essential Raw Cooling Water	Alarm
FE-67-173	Essential Raw Cooling Water	Alarm
FE-67-177	Essential Raw Cooling Water	Alarm
FE-67-183	Essential Raw Cooling Water	Alarm
FE-67-185	Essential Raw Cooling Water	Alarm
FE-67-187	Essential Raw Cooling Water	Alarm
FE-67-189	Essential Raw Cooling Water	Alarm
FE-67-191	Essential Raw Cooling Water	Alarm
FE-67-196	Essential Raw Cooling Water	Alarm
FE-67-198	Essential Raw Cooling Water	Alarm
FE-67-200	Essential Raw Cooling Water	Alarm
FE-67-202	Essential Raw Cooling Water	Alarm
FE-67-204	Essential Raw Cooling Water	Alarm

TABLE 3 (Cont'd)

SQN ORIFICE PLATES

Element No.	System	Application
FE-67-207	Essential Raw Cooling Water	Alarm
FE-67-210	Essential Raw Cooling Water	Alarm
FE-67-214	Essential Raw Cooling Water	Alarm
FE-67-216	Essential Raw Cooling Water	Alarm
FE-67-218	Essential Raw Cooling Water	Alarm
FE-67-220	Essential Raw Cooling Water	Alarm
FE-67-222	Essential Raw Cooling Water	Alarm
FE-67-226	Essential Raw Cooling Water	Alarm
FE-67-231	Essential Raw Cooling Water	Alarm
FE-67-233	Essential Raw Cooling Water	Alarm
FE-67-235	Essential Raw Cooling Water	Alarm
FE-67-237	Essential Raw Cooling Water	Alarm
FE-67-239	Essential Raw Cooling Water	Alarm
FE-67-241	Essential Raw Cooling Water	Alarm
FE-67-245	Essential Raw Cooling Water	Alarm
FE-67-247	Essential Raw Cooling Water	Alarm
FE-67-249	Essential Raw Cooling Water	Alarm
FE-67-251	Essential Raw Cooling Water	Alarm
FE-67-255	Essential Raw Cooling Water	Alarm
FE-67-257	Essential Raw Cooling Water	Alarm
FE-67-259	Essential Raw Cooling Water	Alarm
FE-67-263	Essential Raw Cooling Water	Alarm
FE-67-265	Essential Raw Cooling Water	Alarm
FE-67-267	Essential Raw Cooling Water	Alarm
FE-67-269	Essential Raw Cooling Water	Alarm
FE-67-332	Essential Raw Cooling Water	Alarm
FE-67-333	Essential Raw Cooling Water	Alarm
FE-67-334	Essential Raw Cooling Water	Alarm
FE-67-335	Essential Raw Cooling Water	Alarm
FE-67-337	Essential Raw Cooling Water	Alarm
FE-67-339	Essential Raw Cooling Water	Alarm
FE-67-343	Essential Raw Cooling Water	Alarm
FE-67-345	Essential Raw Cooling Water	Alarm
FE-67-347	Essential Raw Cooling Water	Alarm
FE-67-349	Essential Raw Cooling Water	Alarm
FE-67-351	Essential Raw Cooling Water	Alarm
FE-67-353	Essential Raw Cooling Water	Alarm
FE-67-355	Essential Raw Cooling Water	Alarm
FE-67-357	Essential Raw Cooling Water	Alarm
FE-70-21	Component Cooling System	Alarm
FE-70-81A	Component Cooling System	Indication/Alarm

TABLE 3 (Cont'd)

SQN ORIFICE PLATES

Element No.	System	Application
FE-70-81B	Component Cooling System	Alarm
FE-70-84	Component Cooling System	Alarm
FE-70-95	Component Cooling System	Alarm
FE-70-96	Component Cooling System	Alarm
FE-70-98	Component Cooling System	Alarm
FE-70-105	Component Cooling System	Alarm
FE-70-106	Component Cooling System	Alarm
FE-70-108	Component Cooling System	Alarm
FE-70-115	Component Cooling System	Alarm
FE-70-116	Component Cooling System	Alarm
FE-70-119	Component Cooling System	Alarm
FE-70-124	Component Cooling System	Alarm
FE-70-125	Component Cooling System	Alarm
FE-70-128	Component Cooling System	Alarm
FE-70-142	Component Cooling System	Alarm
FE-70-145	Component Cooling System	Alarm
FE-70-146	Component Cooling System	Alarm
FE-70-147	Component Cooling System	Alarm
FE-70-148	Component Cooling System	Alarm
FE-70-149	Component Cooling System	Alarm
FE-70-150	Component Cooling System	Alarm
FE-70-151	Component Cooling System	Alarm
FE-70-152	Component Cooling System	Alarm
FE-70-155	Component Cooling System	Alarm
FE-70-158	Component Cooling System	Alarm
FE-70-159	Component Cooling System	Alarm
FE-70-164	Component Cooling System	Alarm
FE-70-165	Component Cooling System	Alarm
FE-70-170	Component Cooling System	Alarm
FE-1-152	Main Steam	Indication
FE-1-156	Main Steam	Indication
FE-1-160	Main Steam	Indication
FE-1-164	Main Steam	Indication
FE-2-200	Condensate	Alarm
FE-2-201	Condensate	Alarm
FE-3-142	Main and Aux Feedwater	Indication/Control
FE-3-147	Main and Aux Feedwater	Indication
FE-3-155	Main and Aux Feedwater	Indication
FE-3-163	Main and Aux Feedwater	Indication

TABLE 3 (Cont'd)

SQN ORIFICE PLATES

Element No.	System	Application
FE-3-170	Main and Aux Feedwater	Indication
FE-24-53A	Raw Cooling Water	Alarm
FE-24-53B	Raw Cooling Water	Alarm
FE-59-20	Demin Water & Cask Decon	Breakdown Orifice
FE-67-211	Essential Raw Cooling Water	Restriction
FE-67-253	Essential Raw Cooling Water	Indication
FE-67-277	Essential Raw Cooling Water	Indication
FE-67-280	Essential Raw Cooling Water	Indication
FE-70-81B	Component Cooling System	Indication/Alarm
FE-70-110	Component Cooling System	*
FE-70-132	Component Cooling System	Restriction
FE-70-176	Component Cooling System	Indication/Alarm
FE-70-181	Component Cooling System	Indication/Alarm
FE-70-184	Component Cooling System	Indication/Alarm
FE-70-190	Component Cooling System	Indication/Alarm
FE-70-199	Component Cooling System	Indication
FE-70-200	Component Cooling System	Indication
FE-70-201	Component Cooling System	Indication
FE-70-202	Component Cooling System	Restriction
FE-70-204	Component Cooling System	*
FE-77-230	Waste Disposal System	Indication/Control
FE-77-249	Waste Disposal System	Indication/Control

Note: Asterisk (*) in Application Column denotes instrument purchased according to Contract 73C38-83520-1, but not shown on system drawings or listed in Design Criteria.

TABLE 4

DERIVATION OF "PRECISE" FLOW
WBN AND SQN FLOW ELEMENT FE-3-142

Meter number	FE-3-142	
Fluid metered	Water	
Type of taps	Flange	
Plate material	Type 304 SS	Fa = 1.0008
Range, inches of water	300	
Volume rate, gpm	1,000.00	
Weight rate, lb/hr	497,245.60	
Density (std), specific gravity (water)	1.00000	
Density (act), specific gravity (water)	0.99400	
Viscosity, centipoise	0.68000	
Expansion factor	0.000	
Pressure, psia	1,014.7	
Temperature, °F	100.0	
Beta ratio	0.6913	
Pipe diameter, inches	5.5010	
Plate bore, inches	3.8029	
Reynolds Number (pipe)	839,501	
"Precise flow," gpm	973.18	

TABLE 5

DERIVATION OF "PRECISE" FLOW
WBN AND SQN FLOW ELEMENTS FE-67-61 AND FE-67-62

Meter number	FE-67-61, FE-67-62	
Fluid metered	Water	
Type of taps	Flange	
Plate material	Type 304 SS	Fa = 1.0004
Range, inches of water	400	
Volume rate, gpm	20,000.00	
Weight rate, lb/hr	9,971,924.00	
Density (std), specific gravity (water)	1.00000	
Density (act), specific gravity (water)	0.99670	
Viscosity, centipoise	0.80000	
Pressure, psia	170.7	
Temperature, °F	83.0	
Beta ratio	0.6537	
Pipe diameter, inches	29.2500	
Plate bore, inches	19.1198	
Reynolds Number (pipe)	2,691,312	
"Precise flow," gpm	19,501.63	

TABLE 6

DERIVATION OF "PRECISE" FLOW
WBN AND SQN FLOW ELEMENT FE-70-81B

Meter number	FE-70-81B	
Fluid metered	Water	
Type of taps	Flange	
Plate material	Type 304 SS	Fa = 1.0010
Range, inches of water	100	
Volume rate, gpm	200.00	
Weight rate, lb/hr	99,155.96	
Density (std), specific gravity (water)	1.00000	
Density (act), specific gravity (water)	0.99107	
Viscosity, centipoise	0.68000	
Pressure, psia	134.7	
Temperature, °F	110.0	
Beta ratio	0.7199	
Pipe diameter, inches	3.0680	
Plate bore, inches	2.2085	
Reynolds Number (pipe)	300,162	
"Precise flow," gpm	194.84	

TABLE 7

WBN ORIFICE PLATES

Element No.	System	Application
FE-1-152	Main Steam	Indication
FE-1-156	Main Steam	Indication
FE-1-160	Main Steam	Indication
FE-1-164	Main Steam	Indication
FE-2-200	Condensate	Alarm
FE-2-201	Condensate	Alarm
FE-3-142	Main and Aux Feedwater	Indication/Control
FE-3-147	Main and Aux Feedwater	Indication
FE-3-155	Main and Aux Feedwater	Indication
FE-3-163	Main and Aux Feedwater	Indication
FE-3-170	Main and Aux Feedwater	Indication
FE-3-208	Main and Aux Feedwater	Indication
FE-3-235	Main and Aux Feedwater	Indication
FE-3-238	Main and Aux Feedwater	Indication
FE-3-241	Main and Aux Feedwater	Indication
FE-3-244	Main and Aux Feedwater	Indication
FE-6-107	Heater Drains & Vents	Alarm
FE-6-205	Heater Drains & Vents	Alarm
FE-6-227	Heater Drains & Vents	Alarm
FE-6-229	Heater Drains & Vents	Alarm
FE-6-231	Heater Drains & Vents	Alarm
FE-6-233	Heater Drains & Vents	Alarm
FE-6-240	Heater Drains & Vents	Alarm
FE-6-242	Heater Drains & Vents	Alarm
FE-6-244	Heater Drains & Vents	Alarm
FE-6-246	Heater Drains & Vents	Alarm
FE-6-252	Heater Drains & Vents	Alarm
FE-6-254	Heater Drains & Vents	Alarm
FE-6-256	Heater Drains & Vents	Alarm
FE-6-258	Heater Drains & Vents	Alarm
FE-6-264	Heater Drains & Vents	Alarm
FE-6-266	Heater Drains & Vents	Alarm
FE-6-272	Heater Drains & Vents	Alarm
FE-6-274	Heater Drains & Vents	Alarm
FE-6-280	Heater Drains & Vents	Alarm
FE-6-282	Heater Drains & Vents	Alarm
FE-24-26	Raw Cooling Water	Alarm
FE-24-33	Raw Cooling Water	Alarm
FE-24-33M1	Raw Cooling Water	Alarm
FE-24-39	Raw Cooling Water	Alarm
FE-24-46	Heater Drains & Vents	Alarm

TABLE 7 (Cont'd)

WBN ORIFICE PLATES

Element No.	System	Application
FE-24-53	Raw Cooling Water	Restriction
FE-24-53A	Raw Cooling Water	Alarm
FE-24-53B	Raw Cooling Water	Alarm
FE-24-59	Raw Cooling Water	Alarm
FE-24-64	Raw Cooling Water	Alarm
FE-26-19	High Pressure Fire Protection	Restriction
FE-26-20	High Pressure Fire Protection	Restriction
FE-28-7	Water Treatment and Demineralizers	Indication
FE-41-8	Steam Generator Layup Water Treatment	Indication
FE-59-20	Demin Water & Cask Decon	Breakdown Orifice
FE-62-249	CVCS Boron Recovery	Restriction
FE-67-61	Essential Raw Cooling Water	Alarm
FE-67-62	Essential Raw Cooling Water	Alarm
FE-67-69	Essential Raw Cooling Water	Alarm
FE-67-74	Essential Raw Cooling Water	Alarm
FE-67-78	Essential Raw Cooling Water	Alarm
FE-67-80	Essential Raw Cooling Water	Alarm
FE-67-122	Essential Raw Cooling Water	Alarm
FE-67-136	Essential Raw Cooling Water	Alarm
FE-67-159	Essential Raw Cooling Water	Alarm
FE-67-161	Essential Raw Cooling Water	Alarm
FE-67-163	Essential Raw Cooling Water	Alarm
FE-67-165	Essential Raw Cooling Water	Alarm
FE-67-169	Essential Raw Cooling Water	Alarm
FE-67-171	Essential Raw Cooling Water	Alarm
FE-67-173	Essential Raw Cooling Water	Alarm
FE-67-177	Essential Raw Cooling Water	Alarm
FE-67-183	Essential Raw Cooling Water	Alarm
FE-67-185	Essential Raw Cooling Water	Alarm
FE-67-187	Essential Raw Cooling Water	Alarm
FE-67-189	Essential Raw Cooling Water	Alarm
FE-67-191	Essential Raw Cooling Water	Alarm
FE-67-196	Essential Raw Cooling Water	Alarm
FE-67-198	Essential Raw Cooling Water	Alarm
FE-67-200	Essential Raw Cooling Water	Alarm
FE-67-202	Essential Raw Cooling Water	Alarm
FE-67-204	Essential Raw Cooling Water	Alarm
FE-67-206	Essential Raw Cooling Water	Alarm
FE-67-207	Essential Raw Cooling Water	Alarm
FE-67-209	Essential Raw Cooling Water	Alarm
FE-67-210	Essential Raw Cooling Water	Alarm
FE-67-211	Essential Raw Cooling Water	Restriction

TABLE 7 (Cont'd)

WBN ORIFICE PLATES

Element No.	System	Application
FE-67-214	Essential Raw Cooling Water	Alarm
FE-67-216	Essential Raw Cooling Water	Alarm
FE-67-218	Essential Raw Cooling Water	Alarm
FE-67-220	Essential Raw Cooling Water	Alarm
FE-67-222	Essential Raw Cooling Water	Alarm
FE-67-226	Essential Raw Cooling Water	Alarm
FE-67-231	Essential Raw Cooling Water	Alarm
FE-67-233	Essential Raw Cooling Water	Alarm
FE-67-235	Essential Raw Cooling Water	Alarm
FE-67-237	Essential Raw Cooling Water	Alarm
FE-67-239	Essential Raw Cooling Water	Alarm
FE-67-241	Essential Raw Cooling Water	Alarm
FE-67-245	Essential Raw Cooling Water	Alarm
FE-67-247	Essential Raw Cooling Water	Alarm
FE-67-249	Essential Raw Cooling Water	Alarm
FE-67-251	Essential Raw Cooling Water	Alarm
FE-67-253	Essential Raw Cooling Water	Indication
FE-67-255	Essential Raw Cooling Water	Alarm
FE-67-257	Essential Raw Cooling Water	Alarm
FE-67-259	Essential Raw Cooling Water	Alarm
FE-67-263	Essential Raw Cooling Water	Alarm
FE-67-265	Essential Raw Cooling Water	Alarm
FE-67-267	Essential Raw Cooling Water	Alarm
FE-67-269	Essential Raw Cooling Water	Alarm
FE-67-277	Essential Raw Cooling Water	Indication
FE-67-280	Essential Raw Cooling Water	Indication
FE-67-332	Essential Raw Cooling Water	Alarm
FE-67-333	Essential Raw Cooling Water	Alarm
FE-67-334	Essential Raw Cooling Water	Alarm
FE-67-335	Essential Raw Cooling Water	Alarm
FE-67-337	Essential Raw Cooling Water	Alarm
FE-67-339	Essential Raw Cooling Water	Alarm
FE-67-340	Essential Raw Cooling Water	Alarm
FE-67-343	Essential Raw Cooling Water	Alarm
FE-67-345	Essential Raw Cooling Water	Alarm
FE-67-347	Essential Raw Cooling Water	Alarm
FE-67-349	Essential Raw Cooling Water	Alarm
FE-67-351	Essential Raw Cooling Water	Alarm
FE-67-353	Essential Raw Cooling Water	Alarm
FE-67-355	Essential Raw Cooling Water	Alarm
FE-67-357	Essential Raw Cooling Water	Alarm
FE-67-470	Essential Raw Cooling Water	Alarm

TABLE 7 (Cont'd)

WBN ORIFICE PLATES

Element No.	System	Application
FE-67-471	Essential Raw Cooling Water	Alarm
FE-67-472	Essential Raw Cooling Water	Alarm
FE-67-473	Essential Raw Cooling Water	Alarm
FE-67-474	Essential Raw Cooling Water	Alarm
FE-67-475	Essential Raw Cooling Water	Alarm
FE-67-476	Essential Raw Cooling Water	Alarm
FE-67-477	Essential Raw Cooling Water	Alarm
FE-70-06	Component Cooling System	Alarm
FE-70-20	Component Cooling System	Alarm
FE-70-21	Component Cooling System	Alarm
FE-70-84	Component Cooling System	Alarm
FE-70-95	Component Cooling System	Alarm
FE-70-96	Component Cooling System	Alarm
FE-70-98	Component Cooling System	Alarm
FE-70-105	Component Cooling System	Alarm
FE-70-106	Component Cooling System	Alarm
FE-70-108	Component Cooling System	Alarm
FE-70-110	Component Cooling System	Restriction*
FE-70-112	Component Cooling System	Indication/Alarm
FE-70-115	Component Cooling System	Alarm
FE-70-116	Component Cooling System	Alarm
FE-70-119	Component Cooling System	Alarm
FE-70-124	Component Cooling System	Alarm
FE-70-125	Component Cooling System	Alarm
FE-70-128	Component Cooling System	Alarm
FE-70-132	Component Cooling System	Restriction
FE-70-142	Component Cooling System	Alarm
FE-70-145	Component Cooling System	Alarm
FE-70-146	Component Cooling System	Alarm
FE-70-147	Component Cooling System	Alarm
FE-70-148	Component Cooling System	Alarm
FE-70-149	Component Cooling System	Alarm
FE-70-150	Component Cooling System	Alarm
FE-70-151	Component Cooling System	Alarm
FE-70-152	Component Cooling System	Alarm
FE-70-155	Component Cooling System	Alarm
FE-70-158	Component Cooling System	Alarm
FE-70-159	Component Cooling System	Alarm
FE-70-164	Component Cooling System	Alarm
FE-70-165	Component Cooling System	Alarm
FE-70-170	Component Cooling System	Alarm
FE-70-172	Component Cooling System	Indication/Alarm

TABLE 7 (Cont'd)

WBN ORIFICE PLATES

Element No.	System	Application
FE-70-176	Component Cooling System	Indication/Alarm
FE-70-181	Component Cooling System	Indication/Alarm
FE-70-184	Component Cooling System	Indication/Alarm
FE-70-190	Component Cooling System	Indication/Alarm
FE-70-199	Component Cooling System	Indication
FE-70-200	Component Cooling System	Indication
FE-70-201	Component Cooling System	Indication
FE-70-202	Component Cooling System	Restriction*
FE-70-203	Component Cooling System	Restriction*
FE-70-204	Component Cooling System	Restriction*
FE-70-205	Component Cooling System	Alarm
FE-70-212	Component Cooling System	Alarm
FE-70-214	Component Cooling System	Alarm FE-70-81A
FE-70-81A	Component Cooling System	Indication/Alarm
FE-70-81B	Component Cooling System	Alarm
FE-77-230	Waste Disposal System	Indication
FE-77-249	Waste Disposal System	Indication

* Instrument purchased according to Contract 73C38-83520-1, but not shown in system drawing 47B601-70 (instr. tabulations) or listed in Design Criteria.

TABLE 8

BFN ORIFICE PLATES

Element No.	System	Application
FE-1-13	Main Steam (venturi nozzle)	Alarm/control/PAM
FE-1-25	Main Steam (venturi nozzle)	Alarm/control/PAM
FE-1-36	Main Steam (venturi nozzle)	Alarm/control/PAM
FE-1-50	Main Steam (venturi nozzle)	Alarm/control/PAM
FE-2-29	Condensate and Demin. Water	Control
FE-2-42	Condensate and Demin. Water	Indication
FE-2-45	Condensate and Demin. Water	Indication
FE-2-47	Condensate and Demin. Water	Indication
FE-2-48	Condensate and Demin. Water	Indication
FE-2-151	Condensate and Demin. Water	Restriction
FE-2-191	Condensate and Demin. Water	Restriction
FE-2-208A-J	Condensate and Demin. Water	Indication
FE-2-215	Condensate and Demin. Water	Indication
FE-2-228	Condensate and Demin. Water	Indication
FE-3-6	Feedwater (venturi nozzle)	Control
FE-3-13	Feedwater (venturi nozzle)	Control
FE-3-20	Feedwater (venturi nozzle)	Control
FE-3-78A	Feedwater (venturi nozzle)	Indication/control/PAM
FE-3-78B	Feedwater (venturi nozzle)	Indication/control/PAM
FE-6-16	Heater Drain and Vents	Monitor
FE-6-34	Heater Drain and Vents	Monitor
FE-6-52	Heater Drain and Vents	Monitor
FE-6-56A,B	Heater Drain and Vents	Control
FE-6-57A,B	Heater Drain and Vents	Control
FE-6-58A,B	Heater Drain and Vents	Control
FE-23-36	RHR Service Water	Indication
FE-23-42	RHR Service Water	Indication
FE-23-48	RHR Service Water	Indication
FE-23-54	RHR Service Water	Indication

TABLE 8 (Cont'd)

Element No.	System	Application
FE-24-26	Raw Cooling Water	Restriction
FE-24-31	Raw Cooling Water	Restriction
FE-24-36	Raw Cooling Water	Restriction
FE-24-42	Raw Cooling Water	Restriction
FE-24-47	Raw Cooling Water	Restriction
FE-24-48	Raw Cooling Water	Restriction
FE-24-58	Raw Cooling Water	Restriction
FE-24-66	Raw Cooling Water	Restriction
FE-24-71	Raw Cooling Water	Restriction
FE-24-76	Raw Cooling Water	Restriction
FE-24-81	Raw Cooling Water	Restriction
FE-24-86	Raw Cooling Water	Restriction
FE-24-103	Raw Cooling Water	Restriction
FE-24-108	Raw Cooling Water	Restriction
FE-24-113	Raw Cooling Water	Restriction
FE-24-118	Raw Cooling Water	Restriction
FE-24-123	Raw Cooling Water	Restriction
FE-24-128	Raw Cooling Water	Restriction
FE-24-192	Raw Cooling Water	Restriction
FE-24-193	Raw Cooling Water	Indication
FE-24-205	Raw Cooling Water (annubar)	Indication
FE-24-206	Raw Cooling Water (annubar)	Indication
FE-24-208	Raw Cooling Water (annubar)	Indication
FE-25-4	Raw Cooling Water	Restriction
FE-25-6	Raw Cooling Water	Restriction
FE-25-8	Raw Cooling Water	Restriction
FE-25-50A1 thru A6	Raw Cooling Water (annubar)	Indication
FE-25-50B1 thru B6	Raw Cooling Water (annubar)	Indication
FE-25-65A,B	Raw Cooling Water	Indication

TABLE 8 (Cont'd)

Element No.	System	Application
FE-25-73C	Raw Cooling Water	Restriction
FE-27-147	Condenser Circ. Water	Indication/alarm
FE-28-26	Water Treatment	Filter regulation
FE-28-29	Water Treatment	Filter regulation
FE-28-49	Water Treatment	Filter regulation
FE-28-53	Water Treatment	Filter regulation
FE-28-60	Water Treatment	Filter regulation
FE-28-69	Water Treatment	Filter regulation
FE-28-87	Water Treatment	Filter regulation
FE-28-99	Water Treatment	Filter regulation
FE-28-111	Water Treatment	Filter regulation
FE-28-123	Water Treatment	Filter regulation
FE-28-124	Water Treatment	Filter regulation
FE-28-126	Water Treatment	Filter regulation
FE-28-145	Water Treatment	Filter regulation
FE-63-11	Standby Liquid Control	Indication/alarm/PAM
FE-63-15	Standby Liquid Control	Indication/alarm
FE-67-3	Emergency Equip. Cooling Water	Indication/alarm/PAM
FE-67-6	Emergency Equip. Cooling Water	Indication/alarm/PAM
FE-67-9	Emergency Equip. Cooling Water	Indication/alarm/PAM
FE-67-12	Emergency Equip. Cooling Water	Indication/alarm/PAM
FE-67-27	Emergency Equip. Cooling Water	Restriction
FE-67-28	Emergency Equip. Cooling Water	Restriction
FE-67-29	Emergency Equip. Cooling Water	Restriction
FE-67-30	Emergency Equip. Cooling Water	Restriction
FE-67-31	Emergency Equip. Cooling Water	Restriction
FE-67-32	Emergency Equip. Cooling Water	Restriction
FE-67-33	Emergency Equip. Cooling Water	Restriction
FE-67-34	Emergency Equip. Cooling Water	Restriction

TABLE 8 (Cont'd)

Element No.	System	Application
FE-67-35	Emergency Equip. Cooling Water	Restriction
FE-67-36	Emergency Equip. Cooling Water	Restriction
FE-67-37	Emergency Equip. Cooling Water	Restriction
FE-67-38	Emergency Equip. Cooling Water	Restriction
FE-67-39	Emergency Equip. Cooling Water	Restriction
FE-67-40	Emergency Equip. Cooling Water	Restriction
FE-67-41	Emergency Equip. Cooling Water	Restriction
FE-67-42	Emergency Equip. Cooling Water	Restriction
FE-67-43	Emergency Equip. Cooling Water	Restriction
FE-67-44	Emergency Equip. Cooling Water	Restriction
FE-67-45	Emergency Equip. Cooling Water	Restriction
FE-67-46	Emergency Equip. Cooling Water	Restriction
FE-67-47	Emergency Equip. Cooling Water	Restriction
FE-67-48	Emergency Equip. Cooling Water	Restriction
FE-67-64	Emergency Equip. Cooling Water	Restriction
FE-67-65	Emergency Equip. Cooling Water	Restriction
FE-67-66	Emergency Equip. Cooling Water	Restriction
FE-67-67	Emergency Equip. Cooling Water	Restriction
FE-67-68	Emergency Equip. Cooling Water	Restriction
FE-67-69	Emergency Equip. Cooling Water	Restriction
FE-67-70	Emergency Equip. Cooling Water	Restriction
FE-67-71	Emergency Equip. Cooling Water	Restriction
FE-67-72	Emergency Equip. Cooling Water	Restriction
FE-67-73	Emergency Equip. Cooling Water	Restriction
FE-67-78	Emergency Equip. Cooling Water	Restriction
FE-67-79	Emergency Equip. Cooling Water	Restriction
FE-67-80	Emergency Equip. Cooling Water	Restriction
FE-67-81	Emergency Equip. Cooling Water	Restriction
FE-67-82	Emergency Equip. Cooling Water	Restriction

TABLE 8 (Cont'd)

Element No.	System	Application
FE-67-83	Emergency Equip. Cooling Water	Restriction
FE-67-84	Emergency Equip. Cooling Water	Restriction
FE-68-5	R.W. Recirculation	Indication
FE-68-81	R.W. Recirculation	Indication
FE-69-4A,B	RWCU	Alarm/control
FE-69-13	RWCU	Indication
FE-69-35	RWCU	Indication/control
FE-69-53	RWCU	Indication
FE-69-60	RWCU	Indication/control
FE-69-70	RWCU	Indication
FE-69-101	RWCU	Restriction
FE-70-92	Reactor Bldg. CCW (annubar)	Indication
FE-70-93	Reactor Bldg. CCW (annubar)	Indication
FE-70-94	Reactor Bldg. CCW (annubar)	Indication
FE-70-95	Reactor Bldg. CCW (annubar)	Indication
FE-70-96	Reactor Bldg. CCW (annubar)	Indication
FE-70-97	Reactor Bldg. CCW (annubar)	Indication
FE-70-98	Reactor Bldg. CCW (annubar)	Indication
FE-70-99	Reactor Bldg. CCW (annubar)	Indication
FE-70-100	Reactor Bldg. CCW (annubar)	Indication
FE-70-101	Reactor Bldg. CCW (annubar)	Indication
FE-70-102	Reactor Bldg. CCW	Restriction
FE-70-103	Reactor Bldg. CCW	Restriction
FE-70-104	Reactor Bldg. CCW	Restriction
FE-70-105	Reactor Bldg. CCW	Restriction
FE-70-106	Reactor Bldg. CCW	Restriction
FE-70-107	Reactor Bldg. CCW	Restriction
FE-70-108	Reactor Bldg. CCW	Restriction
FE-70-109	Reactor Bldg. CCW	Restriction

TABLE 8 (Cont'd)

Element No.	System	Application
FE-70-110	Reactor Bldg. CCW	Restriction
FE-70-303	Reactor Bldg. CCW	Restriction
FE-71-1A,B	RCIC	Indication/PAM
FE-71-36	RCIC	Indication/control
FE-73-1	HPCI	Restriction
FE-73-33	HPCI	Indication/control/PAM
FE-74-50	RHR	Indication
FE-74-56	RHR	Indication
FE-74-64	RHR	Indication
FE-74-70	RHR	Indication
FE-74-76	RHR	Indication/control/PAM
FE-75-21	Core Spray	Indication/PAM
FE-75-49	Core Spray	Indication/PAM
FE-75-80	Core Spray	Indication
FE-75-81	Core Spray	Indication
FE-77-6	Radwaste	Monitor
FE-77-16	Radwaste	Monitor
FE-77-52	Radwaste	Alarm
FE-77-91	Radwaste	Alarm
FE-77-103	Radwaste	Restriction
FE-77-126	Radwaste	Restriction
FE-77-127	Radwaste	Restriction
FE-77-298	Radwaste	Restriction
FE-78-24	Fuel Pool Cooling	Control
FE-78-56	Fuel Pool Cooling	Indication
FE-78-56	Fuel Pool Cooling	Indication
FE-84-7	CAD	Indication
FE-84-18	CAD	Indication
FE-84-19	CAD	Control
FE-84-20	CAD	Control

TABLE 9

BFN PAM FLOW SIGNALS REQUIRED BY RG 1.97

RG 1.97 System	Function	BFN System (No.)
Main feedwater	Monitor operation	Feedwater (3)
Suppression chamber spray	Monitor operation	RHR (74)*
Drywell spray	Monitor operation	RHR (74)*
Reactor core isolation cooling (RCIC)	Monitor operation	RCIC (71)
High pressure coolant injection (HPCI)	Monitor operation	HPCI (73)
Core spray (CS) system	Monitor operation	CS (75)
Low pressure coolant injection (LPCI)	Monitor operation	LPCI/RHR (74)
Standby liquid control (SLC)	Monitor operation	SLC (63)**
Residual heat removal (RHR)	Monitor operation	RHR (74)
Cooling water flow to engineered safety features system components	Monitor operation	Emergency equipment cooling water (67)

* Implemented by the LPCI flow signal
** Implemented by the SLC tank level indication

TABLE 10

BFN CONTROL AND PAM FLOW SIGNALS FROM FLOW ELEMENTS

Orifice(s)	Contract	System	Safety Related	Used for Control	Used for PAM Flow
FE-1-13,25,36,50	90744/91750	Main steam	X	X	
FE-2-29	90744/91750	Condensate		X	
FE-3-6,13,20	90744/91750	Feedwater		X	
FE-3-78A,78B	90744/91750	Feedwater		X	X
FE-23-36,42,48,54	90744/91750	RHR Service Water	X		X
FE-67-3,6,9,12	74869	Emer. equip. cooling	X		X
FE-69-35	90744/91750	Reactor water cleanup (RWCU)		X	
FE-69-60	90744/91750	RWCU		X	
FE-71-1A, B	90744/91750	RCIC	X		
FE-71-36	90744/91750	RCIC	X	X	X
FE-73-33	97044/91750	HPCI	X	X	X
FE-74-50,56,64,70	90744/91750	RHR*	X		X
FE-74-76	90744/91750	RHR head spray	X	X	
FE-75-21,49	90744/91750	CS	X		X
FE-78-24	90744/91750	Fuel pool cooling		X	
FE-84-19,20	85116	Containment air dilution (CAD)	X	X	

* Residual heat removal (RHR) provides flow indication for RHR, suppression pool spray, drywell spray, and LPCI systems.

TABLE 11

TYPICAL BWR SAFETY LIMITS FOR INSTRUMENT LOOPS

System	Instrument	Safety Limit	Setpoint
Main steam	PDT-1-50	107.60 psid (max)	100
RCIC	PDT-71-1A	450 inwc (max)	400
HPCI	FS-73-33	None gpm	5000
RHR	FS-74-50	None inwc	8.8
Core spray	FS-75-80	625 gpm (min)	1294
CAD	FT-84-19	134.36 scfm (max)	100

TABLE 12

BLN ORIFICE PLATES

Element No.	System	Application
CA-FE-003	Auxiliary Feedwater	Indication
CA-FE-902	Auxiliary Feedwater	Indication
CA-FE-905	Auxiliary Feedwater	Indication
CA-FE-914	Auxiliary Feedwater	Indication
CA-FE-916	Auxiliary Feedwater	Indication
CD-FE-005	Heater Drains and Vents	Indication
CD-FE-006	Heater Drains and Vents	Indication
CD-FE-007	Heater Drains and Vents	Indication
CD-FE-008	Heater Drains and Vents	Indication
CD-FE-009	Heater Drains and Vents	Indication
CD-FE-010	Heater Drains and Vents	Indication
CD-FE-011	Heater Drains and Vents	Indication
CD-FE-012	Heater Drains and Vents	Indication
*CD-FE-901	Heater Drains and Vents	Indication
*CD-FE-902	Heater Drains and Vents	Indication
*CD-FE-904	Heater Drains and Vents	Indication
*CD-FE-906	Heater Drains and Vents	Indication
*CD-FE-907	Heater Drains and Vents	Indication
CD-FE-908	Heater Drains and Vents	Indication
CD-FE-909	Heater Drains and Vents	Indication
CD-FE-910	Heater Drains and Vents	Indication
*CD-FE-912	Heater Drains and Vents	Indication
CD-FE-916	Heater Drains and Vents	Indication
CD-FE-917	Heater Drains and Vents	Indication
CD-FE-918	Heater Drains and Vents	Indication
CD-FE-919	Heater Drains and Vents	Indication
CD-FE-920	Heater Drains and Vents	Indication
CD-FE-921	Heater Drains and Vents	Indication
CD-FE-922	Heater Drains and Vents	Indication
CD-FE-923	Heater Drains and Vents	Indication
*CD-FE-943	Heater Drains and Vents	Indication
CF-FE-909	Feedwater	Indication
CF-FE-910	Feedwater	Indication
CF-FE-918	Feedwater	Indication
CF-FE-919	Feedwater	Indication
CF-FE-926	Feedwater	Test

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
CM-FE-081	Feedwater	Indication
CM-FE-911	Feedwater	Indication
CM-FE-912	Feedwater	Indication
CM-FE-918	Feedwater	Indication
CM-FE-935	Feedwater	Test
CM-FE-936	Feedwater	Test
CM-FE-950A	Feedwater	Indication
CM-FE-950B	Feedwater	Indication
CM-FE-951A	Feedwater	Indication
CM-FE-951B	Feedwater	Indication
CM-FE-952A	Feedwater	Indication
CM-FE-952B	Feedwater	Indication
CN-FE-900	Condensate Demineralizer	Indication
CN-FE-901	Condensate Demineralizer	Indication
CN-FE-902	Condensate Demineralizer	Indication
CN-FE-903	Condensate Demineralizer	Indication
CN-FE-904	Condensate Demineralizer	Indication
CN-FE-905	Condensate Demineralizer	Indication
CN-FE-906	Condensate Demineralizer	Indication
CN-FE-907	Condensate Demineralizer	Indication
CN-FE-908	Condensate Demineralizer	Indication
CN-FE-909	Condensate Demineralizer	Indication
CN-FE-910	Condensate Demineralizer	Indication
CN-FE-911	Condensate Demineralizer	Indication
CN-FE-912	Condensate Demineralizer	Indication
CN-FE-913	Condensate Demineralizer	Indication
CN-FE-914	Condensate Demineralizer	Indication
CN-FE-915	Condensate Demineralizer	Indication
CN-FE-916	Condensate Demineralizer	Indication
CN-FE-918	Condensate Demineralizer	Indication
CN-FE-919	Condensate Demineralizer	Indication
*CN-FE-928	Condensate Demineralizer	Indication
*CN-FE-929	Condensate Demineralizer	Indication
CS-FE-901	Condensate Storage Transfer	Indication
KC-FE-002	Component Cooling Water	Indication
KC-FE-004	Component Cooling Water	Indication
KC-FE-005	Component Cooling Water	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
KC-FE-006	Component Cooling Water	Indication
KC-FE-007	Component Cooling Water	Indication
KC-FE-142	Component Cooling Water	Indication
KC-FE-147	Component Cooling Water	Indication
KC-FE-902-A	Component Cooling Water	Indication
KC-FE-904-A	Component Cooling Water	Indication
KC-FE-906-A	Component Cooling Water	Indication
KC-FE-908-A	Component Cooling Water	Indication
KC-FE-910-A	Component Cooling Water	Indication
KC-FE-912-B	Component Cooling Water	Indication
KC-FE-914B	Component Cooling Water	Indication
KC-FE-916B	Component Cooling Water	Indication
KC-FE-918B	Component Cooling Water	Indication
KC-FE-919	Component Cooling Water	Indication
KC-FE-921	Component Cooling Water	Indication
*KC-FE-922	Component Cooling Water	Indication
KC-FE-923	Component Cooling Water	Indication
KC-FE-924A	Component Cooling Water	Indication
KC-FE-924B	Component Cooling Water	Indication
KC-FE-927	Component Cooling Water	Indication
*KC-FE-929	Component Cooling Water	Indication
KC-FE-930A	Component Cooling Water	Indication
KC-FE-930B	Component Cooling Water	Indication
KC-FE-931	Component Cooling Water	Indication
KC-FE-932	Component Cooling Water	Indication
KC-FE-935	Component Cooling Water	Indication
KC-FE-936A	Component Cooling Water	Indication
KC-FE-936B	Component Cooling Water	Indication
KC-FE-937	Component Cooling Water	Indication
KC-FE-938	Component Cooling Water	Indication
KC-FE-941	Component Cooling Water	Indication
KC-FE-942A	Component Cooling Water	Indication
KC-FE-942B	Component Cooling Water	Indication
KC-FE-943	Component Cooling Water	Indication
KC-FE-944	Component Cooling Water	Indication
KC-FE-947	Component Cooling Water	Indication
KC-FE-948	Component Cooling Water	Indication
KC-FE-949	Component Cooling Water	Indication
KC-FE-952	Component Cooling Water	Indication
KC-FE-953	Component Cooling Water	Indication
KC-FE-957	Component Cooling Water	Indication
KC-FE-959	Component Cooling Water	Indication
*KC-FE-961	Component Cooling Water	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
KC-FE-963	Component Cooling Water	Indication
KC-FE-965	Component Cooling Water	Indication
KC-FE-966	Component Cooling Water	Indication
KC-FE-967	Component Cooling Water	Indication
KC-FE-969	Component Cooling Water	Indication
KC-FE-971	Component Cooling Water	Indication
KC-FE-973	Component Cooling Water	Indication
KC-FE-979	Component Cooling Water	Indication
KC-FE-981	Component Cooling Water	Indication
KC-FE-982	Component Cooling Water	Indication
KC-FE-983	Component Cooling Water	Indication
KC-FE-985	Component Cooling Water	Indication
KC-FE-987	Component Cooling Water	Indication
KC-FE-989	Component Cooling Water	Indication
KC-FE-993A-A	Component Cooling Water	Indication
KC-FE-993B-B	Component Cooling Water	Indication
KD-FE-003	Control Rod Drive Cooling Water	Indication
KD-FE-004	Control Rod Drive Cooling Water	Indication
KD-FE-005	Control Rod Drive Cooling Water	Indication
KD-FE-901	Control Rod Drive Cooling Water	Indication
KE-FE-001-A	Essential Raw Cooling Water	Indication
KE-FE-002-A	Essential Raw Cooling Water	Indication
KE-FE-003-A	Essential Raw Cooling Water	Indication
KE-FE-004-B	Essential Raw Cooling Water	Indication
KE-FE-005-A	Essential Raw Cooling Water	Indication
KE-FE-006-B	Essential Raw Cooling Water	Indication
KE-FE-553-A	Essential Raw Cooling Water	Indication/Control
KE-FE-559-A	Essential Raw Cooling Water	Indication/Control
KE-FE-904A	Essential Raw Cooling Water	Indication/Control
KE-FE-905A	Essential Raw Cooling Water	Indication/Control
KE-FE-906A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-907A	Essential Raw Cooling Water	Indication
KE-FE-910-B	Essential Raw Cooling Water	Indication/Alarm
KE-FE-911-A	Essential Raw Cooling Water	Indication
KE-FE-912-B	Essential Raw Cooling Water	Indication
KE-FE-913	Essential Raw Cooling Water	Indication/Alarm
KE-FE-913A-A	Essential Raw Cooling Water	Indication/Control
*KE-FE-914-A	Essential Raw Cooling Water	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
KE-FE-916-B	Essential Raw Cooling Water	Indication
KE-FE-918-B	Essential Raw Cooling Water	Indication
KE-FE-920-B	Essential Raw Cooling Water	Indication
KE-FE-922-B	Essential Raw Cooling Water	Indication
KE-FE-925-B	Essential Raw Cooling Water	Indication
KE-FE-928-B	Essential Raw Cooling Water	Indication
KE-FE-930-B	Essential Raw Cooling Water	Indication/Alarm
KE-FE-932-B	Essential Raw Cooling Water	Indication/Alarm
KE-FE-934-B	Essential Raw Cooling Water	Indication/Alarm
*KE-FE-935-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-936-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-939-A	Essential Raw Cooling Water	Indication
KE-FE-941-A	Essential Raw Cooling Water	Indication
KE-FE-943-A	Essential Raw Cooling Water	Indication
KE-FE-944-A	Essential Raw Cooling Water	Indication
KE-FE-945-B	Essential Raw Cooling Water	Indication
KE-FE-946-B	Essential Raw Cooling Water	Indication
KE-FE-947-A	Essential Raw Cooling Water	Indication
KE-FE-949-A	Essential Raw Cooling Water	Indication
KE-FE-952-A	Essential Raw Cooling Water	Indication
KE-FE-955-A	Essential Raw Cooling Water	Indication
KE-FE-957-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-959-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-960-A	Essential Raw Cooling Water	Indication
KE-FE-961-A	Essential Raw Cooling Water	Indication
KE-FE-962-A	Essential Raw Cooling Water	Indication/Alarm
*KE-FE-962A-A	Essential Raw Cooling Water	Indication
KE-FE-962B-A	Essential Raw Cooling Water	Indication/Alarm
*KE-FE-962B-B	Essential Raw Cooling Water	Indication
*KE-FE-963B-A	Essential Raw Cooling Water	Indication/Alarm
*KE-FE-964-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-965-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-965B-B	Essential Raw Cooling Water	Indication
*KE-FE-967-B	Essential Raw Cooling Water	Indication
KE-FE-968-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-968B-B	Essential Raw Cooling Water	Indication/Alarm
*KE-FE-970-B	Essential Raw Cooling Water	Indication
KE-FE-971-B	Essential Raw Cooling Water	Indication
KE-FE-972-B	Essential Raw Cooling Water	Indication/Alarm
KE-FE-978-A	Essential Raw Cooling Water	Indication/Alarm
KE-FE-982-A	Essential Raw Cooling Water	Indication
KE-FE-982-B	Essential Raw Cooling Water	Indication
KE-FE-984-A	Essential Raw Cooling Water	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
KE-FE-986-A	Essential Raw Cooling Water	Indication
KE-FE-989-A	Essential Raw Cooling Water	Indication
KE-FE-990	Essential Raw Cooling Water	Indication
KE-FE-991	Essential Raw Cooling Water	Indication
KE-FE-992	Essential Raw Cooling Water	Indication
KE-FE-999-B	Essential Raw Cooling Water	Indication
KW-FE-901	Raw Cooling Water	Indication
KW-FE-903	Raw Cooling Water	Indication
KW-FE-904	Raw Cooling Water	Indication
KW-FE-905	Raw Cooling Water	Indication
KW-FE-907	Raw Cooling Water	Indication
KW-FE-908	Raw Cooling Water	Indication
KW-FE-909	Raw Cooling Water	Indication
KW-FE-910	Raw Cooling Water	Indication
KW-FE-911	Raw Cooling Water	Indication
KW-FE-912	Raw Cooling Water	Indication
KW-FE-913	Raw Cooling Water	Indication
KW-FE-914	Raw Cooling Water	Indication
KW-FE-915	Raw Cooling Water	Indication
KW-FE-916A	Raw Cooling Water	Indication
KW-FE-916B	Raw Cooling Water	Indication
KW-FE-916C	Raw Cooling Water	Indication
KW-FE-916D	Raw Cooling Water	Indication
KW-FE-917	Raw Cooling Water	Indication
KW-FE-918	Raw Cooling Water	Indication
KW-FE-923	Raw Cooling Water	Indication
KW-FE-927	Raw Cooling Water	Indication
*KW-FE-928	Raw Cooling Water	Indication
NB-FE-435	Chemical Addition & Boron Recovery	Indication
NB-FE-436	Chemical Addition & Boron Recovery	Indication
NB-FE-441	Chemical Addition & Boron Recovery	Indication
NB-FE-443	Chemical Addition & Boron Recovery	Indication
NB-FE-444	Chemical Addition & Boron Recovery	Indication
NB-FE-737	Chemical Addition & Boron Recovery	Indication
NB-FE-741	Chemical Addition & Boron Recovery	Indication
NB-FE-745	Chemical Addition & Boron Recovery	Indication
NB-FE-746	Chemical Addition & Boron Recovery	Indication
NB-FE-747	Chemical Addition & Boron Recovery	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
*NB-FE-767	Chemical Addition & Boron Recovery	Indication
*NB-FE-854	Chemical Addition & Boron Recovery	Indication
*NB-FE-900	Chemical Addition & Boron Recovery	Indication
NB-FE-901	Chemical Addition & Boron Recovery	Indication
NB-FE-903	Chemical Addition & Boron Recovery	Indication
NB-FE-904	Chemical Addition & Boron Recovery	Indication
*NB-FE-905	Chemical Addition & Boron Recovery	Indication
*NB-FE-906	Chemical Addition & Boron Recovery	Indication
NB-FE-907	Chemical Addition & Boron Recovery	Indication
ND-FE-902B	Decay Heat Removal	Indication
ND-FE-907A	Decay Heat Removal	Indication
*ND-FE-909A	Decay Heat Removal	Indication
ND-FE-919A	Decay Heat Removal	Indication
ND-FE-920B	Decay Heat Removal	Indication
NM-FE-900	Spent Fuel Cooling	Indication
NM-FE-901	Spent Fuel Cooling	Indication
*NM-FE-903	Spent Fuel Cooling	Indication
*NM-FE-904	Spent Fuel Cooling	Indication
NS-FE-900A	Reactor Building Spray	Indication
NS-FE-901A	Reactor Building Spray	Indication
NS-FE-901B	Reactor Building Spray	Indication
NV-FE-318	Makeup & Purification	Indication
NV-FE-319	Makeup & Purification	Indication
NV-FE-775	Makeup & Purification	Indication
NV-FE-840	Makeup & Purification	Indication
NV-FE-841-A	Makeup & Purification	Indication
NV-FE-842-B	Makeup & Purification	Indication
NV-FE-843	Makeup & Purification	Indication
NV-FE-844-A	Makeup & Purification	Indication
NV-FE-845-A	Makeup & Purification	Indication
NV-FE-846-B	Makeup & Purification	Indication
NV-FE-847	Makeup & Purification	Indication
NV-FE-848-A	Makeup & Purification	Indication
NV-FE-849-B	Makeup & Purification	Indication
NV-FE-912	Makeup & Purification	Indication

TABLE 12 (Cont'd)

BLN ORIFICE PLATES

Element No.	System	Application
SE-FE-901A	Extraction Steam	Indication/Alarm
SE-FE-901B	Extraction Steam	Indication/Alarm
SE-FE-902A	Extraction Steam	Indication/Alarm
SE-FE-902B	Extraction Steam	Indication/Alarm
SM-FE-942	Main Steam and Reheat	Indication
TK-FE-904	Generator Stator Cooling	Alarm
TK-FE-905	Generator Stator Cooling	Indication/Alarm
YM-FE-901	Water Treatment & Makeup Demin.	Indication/Control
YM-FE-902	Water Treatment & Makeup Demin.	Indication/Control
YM-FE-904	Water Treatment & Makeup Demin.	Indication
YM-FE-906	Water Treatment & Makeup Demin.	Indication
YM-FE-908	Water Treatment & Makeup Demin.	Indication
YM-FE-915	Water Treatment & Makeup Demin.	Indication/Control
YM-FE-916	Water Treatment & Makeup Demin.	Indication/Control
YM-FE-933	Water Treatment & Makeup Demin.	Indication
YM-FE-934	Water Treatment & Makeup Demin.	Indication
YM-FE-949	Water Treatment & Makeup Demin.	Indication
YM-FE-950	Water Treatment & Makeup Demin.	Indication
*WD-FE-072	Waste Disposal	Indication
*WD-FE-900	Waste Disposal	Indication
*WD-FE-903	Waste Disposal	Indication
*WD-FE-904	Waste Disposal	Indication
*WD-FE-914	Waste Disposal	Indication

Note: * Indicates this is not listed in instrument tab but is shown on design criteria drawing for the system.

TABLE 13

FLOW ELEMENT VENDORS FOR BLN

Contract Number	Vendor
85114-2	Babcock and Wilcox (B&W) Company
822050-2	Daniel Measurement Company
833588	Dietrich
837325	Daniel Measurement Company
833434	Daniel Measurement Company
829764	Daniel Measurement Company
86120-2	Crane Co.
836645	Daniel Measurement Company
820235	Chemetron
86243-1	York
86517-2	Chem Seps

TABLE 14

TYPICAL ORIFICES USED FOR PAM OR PRIMARY CONTROL

System	Orifices	Vendor
Decay heat removal and low pressure injection	ND-IFE-902/907	B&W/Bailey
Main feedwater	CF-IFE-909/910	B&W/Bailey
Auxiliary feedwater	CA-IFE-003	Daniel
Containment spray	NS-IFE-900/901	B&W/Bailey
Component cooling system	KC-IFE-002/007	B&W/Bailey
CVCS	NV-IFE-840/844	B&W/Bailey

Panel	Elev	Column	Description	Drawing 47W600	Embedded Drain Header Drawing	Type	Connection Detail**	Remarks
0-L-2	669	sA8	WD Boron Recycle	145	None			See Note 1
1,2-L-5	653	vA7, 10	RHR Pumps, A-A	93	47W479-1	Closed	D1*	OK
1,2-L-12	653	vA7, 10	RHR Pumps, A-A	93	47W479-1	Closed	D1*	OK
1,2-L-13	653	vA7, 10	RHR Pumps, B-B	93	47W479-1	Closed	D1*	OK
0-L-14	651	wA11	Waste Evap Feed Pump	148	47W479-1*	Open*	D1*	See Note 10*
1-L-15	653	uA7	Containment Spray Pump A-A	131	47W479-1*	Open*	K1*	See Note 10*
2-L-15	653	uA9	Containment Spray Pump A-A	131	47W479-1*	Closed*	D1*	OK*
1,2-L-16	653	tA7, 10	Containment Spray Pump B-B	131, 116	47W479-1	Closed	D1*	OK
1,2-L-17	653	sA9	Holdup Tk & Gas Strip Pumps	114	47W479-1	Closed	D1*	OK
1,2-L-22	653	vA7, 10	RHR Pumps, B-B	93	47W479-1	Closed	D1*	OK
0-L-23	734	vA12	Emer Gas Treatmt Unit B	81	None			See Note 2
0-L-25	734	uA12	Emer Gas Treatmt Unit A	81	None			See Note 2
1,2-L-27	714	uA5, 11	Letdown Heat Exchanger	114	47W479-7	Open	D1*	OK See Note 3
1,2-L-43	690	vA3, 13	Volume Control Tank	115	47W479-6	Closed	D1*	OK
1,2-L-47	690	tA4, 12	RCS System	174	None*			See Note 1*
0-L-49	690	rA4	Waste Gas Compressor A Pkg		47W479-6	Closed	D1*	OK See Note 4*
0-L-50	690	qA4	Waste Gas Compressor	137	None			See Note 2
0-L-51	690	rA6	Evap Cond Demin & Filter	181	47W479-6	Closed	D1*	OK
1,2-L-55A,B*	690	vA7, 9	Contmt Spray Heat Exch B	132	47W479-6	Closed	D1*	OK
0-L-59A,B	694	tA14	Waste Disposal	168	47W479-6	Closed	D1*	OK
1,2-L-90	791	145° Ann	Shield Bldg Exh Vent Flow		None			See Note 5*
0-L-103	669	xA8	Waste Disposal System	166	47W479-4*	Closed*		OK See Note 11*
0-L-113A,B	669	sA2	Gas Decay Tank	145	47W479-3	Closed	D1*	OK
0-L-148	653	sA10	Aux Waste Evap Feed Pump	146	None			See Note 1*
1,2-L-150	669	sA4, 6	CVCS Holdup Tank	181	None			See Note 1
1,2-L-153	690	tA5, 11	CVCS Demin and Filter	117	47W479-6	Closed	D1*	OK
0-L-156	690	rA3	Waste Gas Compressor Temp	87	None			See Note 1
1,2-L-179	710	104° Wall	RCS System	172				See Note 6*
1,2-L-180	693	114° 39-0	RCS System	172	None			See Note 1*
1,2-L-181	693	80° 35-0	RCS System	44	None			See Note 2*
1-L-187	679	240° 46-0	React Blg Flr & Eqp Drn Sp	88				See Note 7*

** Connection detail per Drawing 47W479-1

Panel	Elev	Column	Description	Drawing 47W600	Embedded Drain Header: Drawing	Embedded Drain Header: Type	Embedded Drain Header: Connection Detail**	Remarks
2-L-187	679	240° 46-U	React Blg Flr & Eqp Drn Sp	88	None			See Note 2*
1-L-190	679	289°	Waste Disposal System	166	None			See Note 8*
2-L-190	679	289°	Waste Disposal System	166	None			See Note 2*
1,2-L-191	693	238° 50-U	RCS, SIS & FW Misc Instrmts	28				See Note 7*
0-L-203			Gross Failed Fuel Detector	47W625-9	47W476-2			See Table 16
0-L-206	690	wA8	Gas Analyzer	47W625-8				See Table 16
1,2-L-207	690	wA5, 11	RHR Recirc Flow	200	None			See Note 2
0-L-208	714	CL A11	Spent Fuel Pit Pump C	152	None*			See Note 2*
1,2-L-226	679	310° 55-U	Reactor Coolant Flow I	80	None			See Note 8*
1,2-L-227	679	75° 55-U	Reactor Coolant Flow II	80	None			See Note 8*
1,2-L-228	679	195° 55-U	Reactor Coolant Flow II	80	None			See Note 8*
0-L-229	734	vA12	Emer Gas Treat System	177	None			See Note 2*
0-L-230	734	vA12	Emer Gas Treat System	177	None			See Note 2*
1,2-L-231	690	wA8	Hot Sample Room Cub 1A, 2A	47W625-1				See Table 16
1,2-L-232	690	wA8	Hot Sample Room Cub 1B, 2B	47W625-2				See Table 16
0-L-233	690	wA8	Hot Sample Room Cub 1C	47W625-3				See Table 16
0-L-238	653	rA12	Floor Drn Coll Tank Level	148	None			See Note 1
1,2-L-259	714	tA8	RHR HTX A Sup Hdr Flow Xmtr	136	None			See Note 2
1,2-L-268	690	vA4, 12	Volume Control Tank	118	None			See Note 1
1,2-L-296	714	tA8	RHR HTX B Sup Hdr Flow Xmtr	136	None			See Note 2
0-L-314	690	qA4	Waste Gas Compressor B Pkg		47W479-6	Closed	D1*	See Note 4
0-L-316	653	wA8	Tritiated Drn Coll Tk Level	148	None			See Note 1
0-L-317	690	rA4	Waste Gas Compress Sup Press	148	47W479-6*	Closed	D1*	OK*
0-L-350	714	cL A11	Spent Fuel Cooling System	152	None*			See Note 2*
1,2-L-358	693	346°	RCS System	64				See Note 7*
1-L-359	693	9°	RCS System	64				See Note 7*
2-L-359	693	9°	RCS System	64				See Note 6*
1,2-L-360	679	332°	RCS System	75, 105				See Note 7*
1-L-361	679	352°	RCS System	75				See Note 7*
2-L-361	679	352°	RCS System	75	None			See Note 2*
1,2-L-366	679	90°	RCS Pressurizer Relief Tank	44	None			See Note 5*
1,2-L-369	669	uA4, 12	RCS System	156	47W479-3*	Closed*	D1*	OK*

** Connection detail per Drawing 47W479-1

Panel	Elev	Column	Description	Drawing 47W600	Embedded Drain Header Drawing	Type	Connection Detail**	Remarks
0-L-371	669	SA10	Waste Disposal System	166	47W479-3	Closed	01*	OK
1,2-L-374	710	UA5, 11	CVCS System	157	None			See Note 1
0-L-375	673	XA8	Spent Resin Storage Tank	166				See Note 12*
0-L-377	763	UA7	Cask Decon Stor Tank Level	169	None			See Note 2
1,2-L-394	-	45°	Shield Bldg Vent Flow		None			See Note 5*
1,2-L-395	-	45°	Shield Bldg Vent Flow		None			See Note 5*
0-L-397	-	0°	Annulus Flow		None			See Note 5*
1,2-L-398	-	45°	Lower Annulus Flow		None			See Note 5*
1,2-L-399	-	45°	Lower Annulus Flow		None			See Note 5*
1,2-L-433	788	150°	Annulus Diff Pressure	89	None			See Note 2*
1-L-474	705	291° Wall	Train B Containment Pressure	89	None			See Note 2*
2-L-474	705	291° Wall	Train B Containment Pressure	89	None			See Note 9*
1,2-L-515	714	VA5, 11	RHR Rt Line Pipe Brk Detect	288	None			See Note 1
1,2-L-516	714	VA5, 11	RHR Rt Line Pipe Brk Detect	288	None			See Note 1
1,2-L-517	714	VA5, 11	RHR Rt Line Pipe Brk Detect	288	None			See Note 1
1,2-L-518	714	VA5, 11	RHR Rt Line Pipu Brk Detect	288	None			See Note 1

Note 1. Panel has no drain connections.

Note 2. Panel has valved drain connections.

Note 3. The "open" drain header to which this panel is connected has no floor drain or open equipment drain connections and terminates in the Waste Holdup Tank and therefore has the characteristics of a "closed" drain header.

Note 4. The moisture separator is connected to a closed equipment drain. The compressor cooling water drain is released to an open floor drain.

** Connection detail per Drawing 47W479-1

Panel	Elev	Column	Description	Drawing 47W600	Embedded Drain Header Drawing	Embedded Drain Header Type	Embedded Drain Header Connection Detail**	Remarks

Note 5. Panel has capped drain connections.

Note 6. Panel has valved drain connections to a panel drain header; the header has a closed connection to an embedded drain line.

Note 7. Panel has valved drain connections to an open standpipe which is connected to an embedded drain line.

Note 8. Panel has valved drain connections to a panel drain header; such header has one end capped, the other end open.

Note 9. Panel has open drain connections.

Note 10. The "open" drain header to which this panel is connected has floor drains connected at a higher elevation.

Note 11. Drain connected to 3 inch riser at xA11.

Note 12. Panel apparently not used; it was not located where shown on the design drawings or elsewhere during walkdown.

* Data not shown on drawings, obtained from walkdown.

** Connection detail per Drawing 47W479-1

TABLE 16
SQN SAMPLING PANELS

Panel	Elev	Column	Description	Dwg 47W625	Vendor Drawing	Inlet	"Hot"	Outlet	Drain Header Drawing	Drain Header Type	Drain Detail Detail	Drain Detail Type	Comments
1A	690	wA5	Cubicle 1A (Panel 1-L-231)	-1	Waters 57521	1. Hot Leg Loop 1 & 3	Yes	Vol Control Tank	47W479-6	Open	01*	Closed	OK See Note 1
						2. Pressurizer Liquid	Yes						
						3. Pressurizer Gas	Yes						
						4. Vol Control Vent	Yes						
						5. Inlet Mix Bed Demin	Yes						
						6. Outlet Mix Bed Demin	Yes						
						7. Inlet Ion Exchange	Yes						
						8. Outlet Ion Exchange	Yes						
						9. CVCS Holdup Tank Recirc	Yes						
						10. Tritiated Dr Tank Recirc	Yes						
2A	690	wA11	Cubicle 2A (Panel 2-L-231)										Same as 1A
1B	690	wA5	Cubicle 1B (Panel 1-L-232)	-2	Waters 57522	1. Outlet Boric Acid Blend	No	1. Emer Sample Sta	47W479-5	Open	01*	Closed	See Note 2
						2. Accum Tank Hdr Outlet	No	2. 47W600-107					
						3. Contmt Drain Sump 1 & 2	Yes						
						4. Accum Tanks 1, 2, 3, & 4	No						
						5. Steam Gen Blowdown 1	Yes						
						6. Steam Gen Blowdown 2	Yes						
						7. Steam Gas Blowdown 3	Yes						
						8. Steam Gas Blowdown 4	Yes						
2B	690	wA11	Cubicle 2B (Panel 2-L-232)										Same as 1B
1C	690	wA5	Cubicle 1C (Panel 0-L-233)	-3	Waters 57523	1. Upstr Boron Inj Tank 1	Yes	None shown	47W479-6	Open	01*	Closed	OK See Note 1
						2. Dnstr Boron Inj Tank 1	Yes						
						3. Upstr Boron Inj Tank 2	Yes						
						4. Dnstr Boron Inj Tank 2	Yes						
						5. Upstr RHR Exch 1A	Yes						
						6. Upstr RHR Exch 1B	Yes						
						7. Upstr RHR Exch 2A	Yes						
						8. Upstr RHR Exch 2B	Yes						
						9. Wte Evap Cnds Fltr Inlet	Yes						
						10. Wte Evap Demin Outlet	Yes						
						11. Before Evap Cnds Demin 1	Yes						
						12. After Evap Cnds Demin 1	Yes						
						13. Before Evap Cnds Demin 2	Yes						
						14. After Evap Cnds Demin 2	Yes						
						15. SIS Pump Refueling Wtr 2	Yes						
						16. SIS Pump Refueling Wtr 1	Yes						
						17. RHR Pp Min Fl Line 1A & 2B	Yes						
						18. RHR Pp Min Fl Line 2A & 2B	Yes						

TABLE 16
SQN SAMPLING PANELS

Panel	Elev	Column	Description	Dwg 47W625	Vendor Drawing	Inlet	"Hot"	Outlet	Drain Header Drawing	Drain Header Type	Drain Detail Detail	Drain Detail Type	Comments
A4	690	rA12	CVCS Sampling Station	-4	N/A	1. Inlet Boric Acid Tank 1	Yes	N/A	47W479-6	Closed	D1	Closed*	OK
						2. Inlet Boric Acid Tanks C	Yes						
						3. Outlet Batching Tank C	Yes						
						4. Inlet Boric Acid Tank 2	Yes						
B4	714	tA6	CCS & ERCW Sample Sta	-4	N/A	1. Dnstr CCS Ht Exchgr A	No	N/A	47W479-7	Open	H1*	Closed*	OK
						2. Dnstr CCS Ht Exchgr B	No						
						3. Dnstr CCS Ht Exchgr C	No						
						4. ERCW System A	No						
						5. ERCW System B	No						
						6. ERCW System C	No						
E4-1AS	669	uA2	Aux FW Pump Samp Sta	-4	N/A	Aux FW Pump 1A-S	No	N/A	47W479-3	Open	H1*	Closed*	OK
E4-2AS	669	uA14	Aux FW Pump Samp Sta	-4	N/A	Aux FW Pump 2A-S	No						Same as E4-1AS
A5	669	wA7	RWP Filter Samp Sta	-5	N/A	1. Upstr RWP Filter	No	N/A	47W479-3	Closed	D1	Closed*	Open drain OK
						2. Dnstr RWP Filter	No						
B5	714	wA7	SFP Cooling Sys Samp Sta	-5	N/A	1. Upstr SFP Demin	No	N/A	47W479-7	Open	D1	Closed*	OK
						2. Dnstr SFP Demin	No						
C5	734	vA5	Aux Bor Mkup Tk Samp Sta	-5	N/A	Aux Boron Mkup Tk Disch	No	N/A	47W479-11	Closed	H1	Closed*	Open drain OK
D5	653	rA12	FDC Tk Recirc Samp Sta	-5	N/A	FDC Tk Recirc	No	N/A	47W479-1	Open	D1	Closed*	OK
A6	669	sA1	Waste Disposal Samp Sta	-6	N/A	1. Dnstr Laundry Pumps	Yes	N/A	47W479-3	Closed	D1	Closed*	OK
						2. Chem Dr Tk Recirc	Yes						
B6	669	uA14	CVCS Mntr Tk Pump Samp Sta	-6	N/A	Dnstr Mntr Tk Pmps A & B	Yes	N/A	47W479-3	Open	D1	Closed*	OK See Note 1
C6	669	rA15	CVCS Conc Filter Samp Sta	-6	N/A	Dnstr Conc Filter	No	N/A	47W479-3	Closed	D1	Closed*	Open drain OK
D6	669	CL A5	WDS Cnds Pump Samp Sta	-6	N/A	Dnstr Waste Cnds Pumps	No	N/A	47W479-2	Open	D1	Closed*	OK
1-A7	690	sA4	Aux FW Pump Hdr Sam Sta	-7	N/A	1. Aux FW Pump Hdr 1A	No	N/A	47W479-5	Open	D1	Closed*	OK
						2. Aux FW Pump Hdr 1B	No						
2-A7	690	sA12	Aux FW Pump Hdr Sam Sta										Same as 1-A7
B7	669	xA8	WDS Cask Decon Tk Samp Sta	-7	N/A								See Note 3*
1-C7	690	wA5	Boron Analyzer	-7	N/A	1. Dnstr Ltdn Heat Exchgr	Yes	Sample Return	47W479-6	Closed	D1*	Closed*	OK
						2. Dnstr Excess Ltdn HE	Yes						
2-C7	690	wA11	Boron Analyzer										Same as 1-C7

TABLE 16
SQN SAMPLING PANELS

Panel	Elev	Column	Description	Dwg 47W625	Vendor Drawing	Inlet	"Hot"	Outlet	Drain Header Drawing	Drain Header Type	Drain Detail Detail	Drain Detail Type	Comments
1-07	669	uA3	Prim Mkup Water Samp Sta	-7	N/A	Prim Mkup Wtr Stg Tk	Yes	N/A	47W479-3	Closed	D1*	Closed*	OK
2-07	669	uA13	Prim Mkup Water Samp Sta										Same as 1-07
A8	690	wA9	Gas Analyzer Panel (Panel 0-L-206)	-8	Custom-line Control 4918-1	1. Spare (Capped)	-	Vent	47W479-5	Open	D1	Closed*	See Note 2
						2. CVCS Vol Control Tk 1	Yes						
						3. Spent Resin Stg Tk	Yes						
						4. RCS Press Relief Tk 1	Yes						
						5. WDS Gas Decay Tk Auto	Yes						
						6. CVCS Holdup Tk 1	Yes						
						7. Spare (Capped)	-						
						8. CVCS Holdup Tk 2	Yes						
						9. WDS Gas Decay Tk Man	Yes						
						10. Spare (Capped)	-						
						11. Spare (Capped)	-						
						12. CVCS Vol Control Tk 2	Yes						
						13. RCS Press Relief Tk 2	Yes						
						14. Spare (Capped)	-						
						15. Spare (Capped)	-						
						16. Spare (Capped)	-						
A9	734	uA11	Emergency Sample Sta	-9	N/A	1. Hot Leg Loop 1 & 3-2	Yes	N/A	47W479-11	Open	H1	Closed*	OK See Note 1
						2. Stm Gen Bldn 1 - 2	Yes						
						3. Stm Gen Bldn 2 - 2	Yes						
						4. Stm Gen Bldn 3 - 2	Yes						
						5. Stm Gen Bldn 4 - 2	Yes						
						6. Stm Gen Bldn 4 - 1	Yes						
						7. Stm Gen Bldn 3 - 1	Yes						
						8. Stm Gen Bldn 2 - 1	Yes						
						9. Stm Gen Bldn 1 - 1	Yes						
						10. Hot Leg Loop 1 & 3-1	Yes						
B9	669	CL A11	Aux Waste Evap Sampler	-9	N/A	1. Distillate	Yes	1. Distillate	None				N/A
						2. Concentrate	Yes	2. Concentrate					
C9	669	CL A10	Waste Evap Sampler	-9	N/A	1. Distillate	Yes	1. Distillate	None				N/A
						2. Concentrate	Yes	2. Concentrate					
D9	669	rA14	Evap Pkg A & B Sampler	-9	N/A	1. Evap A Distillate	Yes	1. Evap A Distillate	None				N/A
						2. Evap A Concentrate	Yes	2. Evap A Concentrate					
						3. Evap B Distillate	Yes	3. Evap B Distillate					
						4. Evap B Concentrate	Yes	4. Evap B Concentrate					

TABLE 16
SQN SAMPLING PANELS

Panel	Elev	Column	Description	Dwg 47W625	Vendor Drawing	Inlet	"Hot"	Outlet	Drain Header Drawing	Drain Header Type	Drain Detail Detail	Drain Detail Type	Comments
1-E9	714	wA4	Gross Failed Fuel Detector	-9	N/A								See Note 3*
2-E9	714	wA12	Gross Failed Fuel Detector	-9	N/A	Hot Legs 1 & 3	Yes	Ltdn HE	None			-	N/A
A13	714	wA12	Hot Reactor Coolant Samp Mod	-13	Not stated								See Note 3*
1-20	706	xA5	UHI Water Accum Tk Samp Sta	-17	N/A	UHI Water Accum Tk	No	N/A	47W479-6	Closed	HI*	Closed*	Open drain OK
2-20	706	xA11	UHI Water Accum Tk Samp Sta	-17	N/A	UHI Water Accum Tk	No	N/A	47W479-6	Closed	DI	Closed*	Open drain OK
1-A19	690	wA5	Liquid Sampling Panel (Panel 1-L-567)	-19	N/A	1. RHR Exchgr 1A 2. RHR Exchgr 1B 3. Hot Leg 1 4. Hot Leg 3	Yes Yes Yes Yes	Panel 1-B19	See 1-B19				See 1-B19
2-A19	690	wA11	Liquid Sampling Panel (Panel 2-L-567)	-19	N/A	Same as 1-A19	Yes	Panel 2-B19	See 2-B19				See 2-B19
1-B19	690	wA5	Chemical Analysis Panel (Panel 1-L-568)	-19	N/A	Panels 1-A19 & 1-C19	Yes	N/A	47W479-5	Open	DI	Closed*	See Note 2
2-B19	690	wA11	Chemical Analysis Panel (Panel 2-L-568)	-19	N/A	Panels 2-A19 & 2-C19	Yes						Same as 1-B19
1-C19	690	wA5	Contmt Air Sampling Panel (Panel 1-L-569)	-19	N/A	Containment Air	No	Panel 1-B19	See 2-B19				See 1-B19
2-C19	690	wA11	Contmt Air Sampling Panel (Panel 2-L-569)	-19	N/A	Containment Air	No	Panel 2-B19	See 1-B19				See 2-B19

N/A = Not applicable

Note 1: The "open" drain header to which this panel is connected has no floor drains or open equipment drain connections and terminates in the Waste Holdup Tank and therefore has the characteristics of a "closed" drain header.

Note 2: The "open" drain header to which this panel is connected has floor drains connected at a higher elevation.

Note 3: Panel apparently not used; it was not located where shown on the design drawings or elsewhere during walkdown.

* Data obtained from walkdown.

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
0-L-014	676.0	A10-W	47W600-148	Wast Evap Feed Pmp			Capillaries; no drain
0-L-051	713.0	A6-R	47W600-181	Evap Cond Demin and Filt Pnl	D1	47W479-6	With 0-L-338 and 1,2-L-60A/B
0-L-052	713.0	A11-R	47W600-117	BA Trans Pmps A-A & B-B Pnl			Capillaries; no drain
0-L-053A	692.0	A7-W	47W600-083	Conds Tk C & Refueling Wtr Pmp Pnl			Capillaries; no drain
0-L-053B	692.0	A7-W	47W600-125	Refueling Wtr Purif Pmp Pnl	D1	47W479-3	
0-L-059	713.0	A14-T	47W600-168	Waste Disposal Pnl	D1	47W479-6	Air lines into open drain on north side of column A14-T
0-L-094	713.0	A13-Q	47W600-038	Boric Acid Tank C Pnl			Capillaries and electrical; no drain
0-L-103	692.0	A8-X	47W600-166	Waste Disposal Sys Pnl	H1	47W479-4	With sink B-7
0-L-104A	692.0	A7-W	47W600-083	Cnds Tks A & B Cnds Pmps Pnl			Capillaries; no drain
0-L-104B	692.0	A7-W	47W600-083	Cnds Tks A & B Cnds Pmps Pnl			Capillaries; no drain
0-L-111	692.0	A2-Q	47W600-084	Laundry & Hot Shower Chem Dr Pmp Pnl			Capillaries; no drain
0-L-113A	692.0	A2-S	47W600-145	Gas Decay Tk Pnl	)D1	47W479-3	
0-L-113B	692.0	A2-S	47W600-145	Gas Decay Tk Pnl	)		
0-L-142A	713.0	A3-R	47W600-042	Waste Gas Compr A & B Lvl Pnl	)		Capillaries; no drain
0-L-142B	713.0	A4-Q	47W600-042	Waste Gas Compr A & B Lvl Pnl	)		
0-L-148	676.0	A10-S	47W600-146	Aux Wst Evap Feed Pmp Pnl			Capillaries; no drain
0-L-154	692.0	A14-S	47W600-154	Concentrate Filt Pnl			Under construction
0-L-206	713.0	A9-W	47W625-8	Gas Analyzer Pnl (Samp)	D1	47W479-6	With 2-L-231
0-L-208	737.0	A11-CL	47W600-152	Spent Fuel Pit Pmp C Pnl	D1	47W479-7	With 0-L-350
0-L-233	713.0	A7-W	47W625-3	Hot Sample Room Cubicle 1C	D1	47W479-6	With 1-L-231
0-L-238	676.0	A12-R	47W600-148	Floor Dr Collector Tk Lvl Pnl			Capillaries; no drain

* Connection detail per Drawing 47W479-1

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
0-L-269	692.0	A4-S	47W600-146	Charcoal HEPA Filt Press Pnl	D1	47W479-3	
0-L-302	713.0	A12-Q	47W600-128	Boric Acid Tk C Pnl			Capillaries and electrical; no drain
0-L-305	713.0	A13-Q	47W600-128	Boric Acid Tk C Pnl			Capillaries and electrical; no drain
0-L-306	713.0	A12-Q	47W600-128	Boric Acid Tk C Pnl			Capillaries and electrical; no drain
0-L-307	713.0	A13-R	47W600-128	Boric Acid Batching Tk Pnl			Capillaries and electrical; no drain
0-L-310	692.0	A1-S	47W600-084	Chemical Dr Tk Lvl Pnl			Capillaries; no drain
0-L-311	692.0	A8-X	47W600-146	Cask Decon Coll Pmp Pnl	D1	47W479-4	Into floor drain collector tank
0-L-312	692.0	A1-R	47W600-084	Laundry & Hot Shower Tk A Lvl Pnl			Capillaries; no drain
0-L-313	692.0	A1-Q	47W600-084	Laundry & Hot Shower Tk B Lvl Pnl			Capillaries; no drain
0-L-316	676.0	A9-W	47W600-148	Trit Dr Collector Tk Lvl Pnl			Capillaries; no drain
0-L-317	713.0	A4-R	47W600-148	Wst Gas Compr Sup Press Pnl	D1	47W479-6	
0-L-338	713.0	A5-R	47W600-165	CCS Ht Exch Isol Pnl	D1	47W479-6	With 0-L-51 and 1,2-L-60A/B
0-L-350	737.0	A11-W	47W600-152	Spent Fuel Cool Sys Pnl	D1	47W479-7	With 0-L-208
0-L-370	737.0	A5-W	47W600-168	Spent Fuel Pit Pnl	D1	47W479-7	
0-L-371	692.0	A10-S	47W600-166	Wste Disp Sys Pnl	D1	47W479-3	
0-L-375	692.0	A11-X	47W600-166	Spent Resin Stor Tk Pnl			Capillaries; no drain
0-L-445	713.0	A13-R	47W600-128	Boric Acid Trans Pnl			Capillaries; no drain
0-L-471	713.0	A4-R	47W600-087	Wst Gas Compr Temp Pnl			Capillaries; no drain
0-L-473	692.0	A4-S	47W600-150	WD Vt Header Flow Pnl	D1	47W479-3	In gas decay tank room
0-L-498	676.0	A11-R	47W600-244	CDWE Feed Pmp Inlet Press Pnl	D1	47W479-1	With 1,2-L-17

* [illegible]tion detail per Drawing 47W479-1

384[illegible] (12/24/87)

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
0-L-564	692.0	A14-U	47W600-275	Monitor Tk Pmp Pnl	01	47W479-3	With sink B6
Sink A4	713.0	A12-R	47W625-4	CVCS Sampling Sink	01	47W479-6	Into equipment drain next to pump
Sink B5	737.0	A7-W	47W625-5	Spent Fuel Pit Demin Samp Sink	01	47W479-7	Into side of tee; top of tee open
Sink D5	676.0	A12-S	47W625-5	Floor Drain Coll Tank Recirc Samp Sink	01	47W479-1	Into aux bldg floor & equip drain sump
Sink A6	692.0	A1-S	47W625-6	Waste Disposal Samp Sink	01	47W479-3	
Sink B6	692.0	A14-U	47W625-6	CVCS Mont Tank Samp Sink	01	47W479-3	With 0-L-564
Sink C6	692.0	A15-R	47W625-6	CVCS Unstr Conc Fltr Samp Sink	01	47W479-2	Into floor drain collector tank
Sink D6	692.0	A5-CL	47W625-6	WDS Waste Conds Pump Samp Sink	--	47W479-4	Into floor drain collector tank via open funnel drain
Sink B7	692.0	A8-X	47W625-8	WDS Cask Decontn Tank Samp Sink	H1	47W479-4	With 0-L-103
Sink A9	757.0	A11-U	47W625-9	Emergency Sampling Sink	H1	47W479-11	Into floor drain collector tank
1-L-005	676.0	A7-V	47W600-093	RHR Pmps A-A	01	47W479-1	
1-L-010	757.0	A8-R	47W600-052	Aux Cntl Rm Pnl			Electrical; no drain
1-L-011A	757.0	A6-R	47W600-058	Aux Cntl Rm Pnl			Electrical; no drain
1-L-011B	757.0	A6-R	47W600-058	Aux Cntl Rm Pnl			Electrical; no drain
1-L-012	676.0	A7-V	47W600-093	RHR Pmp A-A Pnl	01	47W479-1	Inlet pressure gage drain valved
1-L-013	676.0	A7-V	47W600-093	RHR Pmp B-B Pnl	01	47W479-1	Inlet pressure gage drain valved
1-L-015	676.0	A7-U	47W600-131	Containment Spray Pmp A	01	47W479-1	With 1-L-288; inlet pressure gage drain valved
1-L-016	676.0	A7-T	47W600-131	Containment Spray Pmp B	01	47W479-1	Inlet pressure gage drain valved
1-L-017	676.0	A9-S	47W600-114	Holdup Gas Stripper Pmps	01	47W479-1	With 0-L-498 and 2-L-17; inlet pressure gage drain valved
1-L-022	676.0	A7-V	47W600-093	RHR Pmps B-B	01	47W479-1	

* Connection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-024	737.0	A6-W	47W600-131	Comp Cool Bstr Pmp AA & BB Pnl			Valved
1-L-027	737.0	A6-T	47W600-114	Letdown Heat Exchanger Pnl	--	47W479-7	Into 3-inch standpipe with soft plug; then into floor drain collector tank
1-L-042A	713.0	A4-V	47W600-154	Boron Injection Pnl	)		
1-L-042B	713.0	A4-V	47W600-154	Boron Injection Pnl	)D1	47W479-6	With 1-L-348A/B and 1-L-554
1-L-043	713.0	A3-V	47W600-115	Volume Cntr Tk Pnl	)		
1-L-046	713.0	A6-T	47W600-115	Seal Wtr Heat Exch Pnl	D1	47W479-6	With 1-L-349A/B
1-L-047	713.0	A4-T	47W600-174	RCS System Pnl			Electrical; no drain
1-L-048	713.0	A2-T	47W600-035	Component Cooling Pmp 1B-B Pnl			Valved
1-L-055A	713.0	A7-V	47W600-132	Containment Spray Heat Exch Pnl B	)D1	47W479-6	
1-L-055B	713.0	A7-V	47W600-164	Containment Spray Heat Exch Pnl B	)		
1-L-057	713.0	A3-T	47W600-035	Component Cooling Pmp 1A-A Pnl	--	47W479-5	Into 2-inch standpipe with soft plug; then into floor drain collector tank
1-L-060A	713.0	A6-R	47W600-115	Spent Fuel Pit Demin & Filt Pnl	)D1	47W479-6	With 0-L-51, 0-L-338, and 2-L-60A/B
1-L-060B	713.0	A6-R	47W600-115	Spent Fuel Pit Demin & Filt Pnl	)		
1-L-061	692.0	A4-U	47W600-167	Charging Pump 1B & 1C Panel			Not located; not where shown
1-L-062	716.0	Az 90	47W600-172	RCS Sys Pnl			Drains down into crane wall at Azimuth (Az) 76°
1-L-063	716.0	Az 122	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-064	716.0	Az 78	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-089	716.0	Az 274	47W600-272	Cntmt Sump Lvl Transmitter Panel			Capillaries and electrical; no drain
1-L-091	716.0	Az 173	47W600-120	RCS Wide Range Press Pnl			Capillaries and electrical; no drain
1-L-101	716.0	Az 71	47W600-272	Cntmt Sump Level Panel			Capillaries and electrical; no drain
1-L-107	692.0	A7-U	47W600-163	Safety Inj Pmps Pnl	--	47W479-3	With 1-L-136; partly D1, partly valved

* ...ction detail per Drawing 47W479-1

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-108A	692.0	A3-U	47W600-082	Primary Makeup Wtr & Monitor Tk Pnl	01	47W479-3	With 1-L-137
1-L-108B	692.0	A3-U	47W600-082	Primary Makeup Wtr & Monitor Tk Pnl			
1-L-112A	692.0	A5-T	47W600-118	Charging Pmp 1B & 1C Pnl	01	47W479-3	With 1-L-335
1-L-112B	692.0	A5-T	47W600-118	Charging Pmp 1B & 1C Pnl			
1-L-134	702.8	Az 104	47W600-044	Press Tk Level Pnl			Not located; not where shown
1-L-135	713.0	A14-Q	47W600-117	Boric Acid Filter Pnl			Capillaries and electrical; no drain
1-L-136	692.0	A7-V	47W600-174	Safety Inj Pmp 1A & 1B Pnl	01	47W479-3	With 1-L-107
1-L-137	692.0	A3-U	47W600-187	Cent Chg Pmp Response Time Test Pnl	01	47W479-3	With 1-L-108A/B
1-L-140	676.0	A5-U	47W600-144	Passive RB Sump Lvl Pnl			Capillaries, no drain
1-L-141	713.0	A3-U	47W600-043	Boric Acid To Blender Pnl			Electrical; no drain
1-L-150	692.0	A4-S	47W600-181	CVCS Holdup Tk Pnl			Capillaries, no drain
1-L-153	713.0	A5-T	47W600-117	CVCS Demin and Filt Pnl	01	47W479-6	
1-L-170A	716.0	Az 50	47W600-142	Accum No 1 Pnl	01	47W476-2	With 1-L-171
1-L-170B	716.0	Az 40	47W600-142	Accum No 1 Pnl			
1-L-170C	716.0	Az 45.5	47W600-142	Accum No 1 Pnl			Not located; not where shown
1-L-171	716.0	Az 50	47W600-142	Accum No 1 Pnl	01	47W476-2	With 1-L-170A/B
1-L-172A	716.0	Az 130	47W600-142	Accum No 2 Pnl			Inaccessible
1-L-172B	716.0	Az 139.5	47W600-142	Accum No 2 Pnl	01	47W476-2	
1-L-172C	716.0	Az 145.5	47W600-142	Accum No 2 Pnl			Not located; not where shown
1-L-173	716.0	Az 130	47W600-142	Accum No 2 Pnl			Inaccessible
1-L-174	716.0	Az 234	47W600-032	Accum No 3 Pnl	01	47W476-2	With 1-L-184A/B (spares) and 1-L-191A/B
1-L-175A	716.0	Az 214	47W600-032	Accum No 3 Pnl	01	47W476-2	
1-L-175B	716.0	Az 214	47W600-032	Accum No 3 Pnl			

* Connection detail per Drawing 47W479-1

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-175C	716.0	Az 225	47W600-032	Accum No 3 Pnl			Not located; not where shown
1-L-176	716.0	Az 304	47W600-032	Accum No 4 Pnl	D1	47W476-2	With 1-L-185A/B
1-L-177	716.0	Az 304	47W600-032	Accum No 4 Pnl			Valved
1-L-179	716.0	Az 98	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-180	716.0	Az 114	47W600-172	RCS Sys Pnl			Not located; not where shown
1-L-181	702.8	Az 70	47W600-044	RCS Sys Pnl	D1	47W476-2	
1-L-182A	716.0	Az 180	47W600-026	RC Stm & Fw Safety Set I Pnl	)		
1-L-182B	716.0	Az 180	47W600-026	RC Stm & Fw Safety Set I Pnl	)D1	47W476-2	
1-L-182C	716.0	Az 180	47W600-026	RC Stm & Fw Safety Set I Pnl	)		
1-L-183A	716.0	Az 0	47W600-027	RC Stm & Fw Safety Set II Pnl	)		
1-L-183B	716.0	Az 0	47W600-027	RC Stm & Fw Safety Set II Pnl	)		
1-L-183C	716.0	Az 0	47W600-027	RC Stm & Fw Safety Set II Pnl	)D1	47W476-2	With 1-L-358 and 1-L-359
1-L-183D	716.0	Az 0	47W600-027	RC Stm & Fw Safety Set II Pnl	)		
1-L-183E	716.0	Az 357	47W600-027	RC Stm & Fw Safety Set II Pnl	)		
1-L-185B	716.0	Az 294	47W600-029	RC Stm & Fw Safety Set IV Pnl	)D1	47W476-2	With 1-L-176
1-L-185C	716.0	Az 300	47W600-029	RC Stm & Fw Safety Set IV Pnl	)		
1-L-187	702.8	Az 242	47W600-088	Reac Bldg Floor & Equip Dr Sump Pnl			Into floor drain at Az 219°
1-L-190	702.8	Az 288	47W600-166	Wst Disp Sys Pnl			Into floor drain at Az 270°
1-L-191	716.0	Az 238	47W600-028	RC SIS & Fw Pnl	D1	47W476-2	With 1-L-174 and 1-L-184A/B (Spares)
1-L-203	737.0	A4-W	47W625-9	Gross Failed Fuel Det Pnl			In locked room (probably no drain; see 2-L-203)
1-L-207	713.0	A5-V	47W600-118	Volume Control Tk Pnl			Capillaries; no drain
1-L-226	702.8	Az 168.7	47W600-307	Reactor Coolant Flow Panel	)		
1-L-227	702.8	Az 157	47W600-307	Reactor Coolant Flow Panel	)		Into floor drain at Az 169°
1-L-228	702.8	Az 145	47W600-307	Reactor Coolant Flow Panel	)		
1-L-231	713.0	A5-W	47W625-1	Hot Sample Room Cubicle 1A	D1	47W479-6	With 0-L-233

* [illegible]ction detail per Drawing 47W479-1

TABLE 17
NON HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-232	713.0	A6-W	47W625-2	Hot Sample Room Cubicle 1B	D1	47W479-5	Into floor drain collector tank
1-L-263	702.8	Az 304	47W600-289	RCP Loop 4 Flow Sw Pnl			Into floor drain at Az 319°
1-L-264	702.8	Az 123	47W600-290	RCP Loop 2 & 3 Flow Sw Pnl			Into floor drain at Az 145°
1-L-268	713.0	A4-V	47W600-118	Vol Cntl Tk Pnl			Capillaries and electrical; no drain
1-L-271	702.8	Az 40	47W600-289	RCP Loop 1 Flow Sw Pnl			Into floor drain at Az 342°
1-L-284	716.0	Az 87	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-285	716.0	Az 91	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-287	676.0	A6-T	47W600-132	Cntmt Spray Htr B Pnl			No drain
1-L-288	676.0	A7-U	47W600-132	Cntmt Spray Htr A Pnl	D1	47W479-1	With 1-L-15
1-L-290	737.0	A5-W	47W600-132	Thrm Barrier Flow Trans D Pnl			Valved
1-L-292	692.0	A5-W	47W600-325	Thrm Barrier Sup Hdr Flow Xmtr B Pnl			Valved
1-L-301	713.0	A11-R	47W600-128	Boric Acid Tk A Pnl			Capillaries and electrical; no drain
1-L-303	713.0	A12-Q	47W600-128	Boric Acid Tk A Pnl			Capillaries and electrical; no drain
1-L-304	713.0	A12-Q	47W600-128	Boric Acid Tk A Pnl			Capillaries and electrical; no drain
1-L-328	716.0	Az 95.3	47W600-172	RCS Sys Pnl			Not located; not where shown
1-L-330	716.0	Az 102	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 76°
1-L-335	692.0	A5-T	47W600-163	Component Cool Pnl	D1	47W479-3	With 1-L-112A/B
1-L-340	713.0	A4-V	47W600-292	RVLIS II Pnl			Capillaries and electrical; no drain
1-L-346	713.0	A5-W	47W600-143	Boron Inj Tk Pnl	D1	47W479-6	Under construction
1-L-347	713.0	A5-W	47W600-143	Boron Inj Tk Pnl			Capillaries and electrial; no drain

* Connection detail per Drawing 47W479-1

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-348	713.0	A4-V	47W600-181	Seal Water Flow Pnl	D1	47W479-6	With 1-L-42A/B, 1-L-43, and 1-L-554
1-L-349A	713.0	A6-T	47W600-134	Seal Water Htx Pnl	)D1	47W479-6	With 1-L-46
1-L-349B	713.0	A6-T	47W600-134	Seal Water Htx Pnl	)		
1-L-358	716.0	Az 341	47W600-064	RCS Sys Pnl	)D1	47W476-2	With 1-L-83A/E
1-L-359	716.0	Az 7.6	47W600-064	RCS Sys Pnl	)		
1-L-360	716.0	Az 336	47W600-075	RCS Sys Pnl			Inaccessible
1-L-361	716.0	Az 330	47W600-075	RCS Sys Pnl			Inaccessible
1-L-366	702.8	Az 104	47W600-044	RCS Press Relief Tk Pnl			Capillaries; no drain
1-L-369	692.0	A7-U	47W600-156	RCS Sys Pnl	D1	47W479-3	
1-L-374A	733.0	A5-U	47W600-158	CVCS Sys Pnl			Electrical; no drain
1-L-374B	733.0	A5-U	47W600-158	CVCS Sys Pnl			Air and electrical; no drain
1-L-384	716.0	Az 13	47W600-064	RCS System Pnl			Not located; not where shown
1-L-387	692.0	A13-S	47W600-271	Evap Inlet Steam Flow Pnl			No drain
1-L-388	713.0	A4-V	47W600-292	RVLIS 1 Pnl			Capillaries and electrical; no drain
1-L-393	713.0	A6-W	47W625-7	Boron Analyzer Instr Panel	D1	47W479-6	In hot sample room
1-L-430	692.0	A12-R	47W600-271	Vent Cond Comp Control Pnl			No drain
1-L-446	782.0	A3-V	47W600-136	Reac Cool Flow Modifier Pnl			Not located; not where shown
1-L-447	782.0	A3-V	47W600-136	Reac Cool Flow Modifier Pnl			Not located; not where shown
1-L-475	702.8	Az 321	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		
1-L-476	702.8	Az 337	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		
1-L-477	702.8	Az 348.7	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		Into floor drain at Az 342°
1-L-478	702.8	Az 23	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		
1-L-479	702.8	Az 34	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		
1-L-480	702.8	Az 39	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		

* [illegible]ction detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
1-L-485	692.0	A13-S	47W600-271	30 GPM Boric Acid Evap Pnl			No drain
1-L-501	702.8	Az 218	47W600-307	Reactor Coolant Flow Panel (SG-3)	)		Into floor drain at Az 189°
1-L-502	702.8	Az 205	47W600-307	Reactor Coolant Flow Panel (SG-3)	)		
1-L-503	702.8	Az 193	47W600-307	Reactor Coolant Flow Panel (SG-3)	)		
1-L-554	713.0	A4-V	47W600-124	SIS Test Header Press Pnl	D1	47W479-6	With 1-L-42A/B, 1-L-43, and 1-L-348A/B
1-L-556	713.0	A4-V	47W600-186	PMW to BA Blender Flow Pnl			Air and electrical; no drain
1-L-558	713.0	A3-U	47W600-129	Pri Wtr to Demin Flow Pnl			Into 2-inch standpipe with soft plug - not shown
1-L-559	702.8	Az 145	47W600-290	RCP Loop 2 & 3 Return Flow Pnl			Into floor drain at Az 145°
1-L-560	702.8	Az 38.5	47W600-289	RCP Loop 1 Return Flow Pnl			Into floor drain at Az 342°
1-L-561	702.8	Az 311	47W600-289	RCP Loop 4 Return Flow Pnl			Into floor drain at Az 319°
1-L-598	702.8	Az 123	47W600-028	RC, Stm & Fw Pnl			Valved
1-L-655	692.0	A5-W	47W600-325	Boron Injection Pnl			Not located; not where shown
1-L-659	716.0	Az 100	47W600-331	RCS System Pnl			Not located; not where shown
1-L-660	716.0	Az 76.5	47W600-332	RCS System Pnl			Not located; not where shown
1-L-661	716.0	Az 56	47W600-332	RCS System Pnl			Not located; not where shown
1-L-662	716.0	Az 56	47W600-332	RCS System Pnl			Not located; not where shown
2-L-005	676.0	A10-V	47W600-093	RHR Pmps A-A	D1	47W479-1	
2-L-010	757.0	A8-R	47W600-053	Aux Cntl Rm Pnl			Electrical; no drain
2-L-011A	757.0	A10-R	47W600-056	Aux Cntl Rm Pnl			Electrical; no drain
2-L-011B	757.0	A10-R	47W600-056	Aux Cntl Rm Pnl			Electrical; no drain
2-L-012	676.0	A10-V	47W600-093	RHR Pmp A-A Pnl	D1	47W479-1	Inlet pressure gage drain valved

* Connection detail per Drawing 47W479-1

TABLE 17
WBN HOT PANEL TABULATION

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-013	676.0	A9-V	47W600-093	RHR Pmp B-B Pnl	01	47W479-1	Inlet pressure gage drain valved
2-L-015	676.0	A9-U	47W600-131	Containment Spray Pmp A	01	47W479-1	Inlet pressure gage drain valved
2-L-016	676.0	A10-T	47W600-116	Containment Spray Pmp B	01	47W479-1	Inlet pressure gage drain valved
2-L-017	676.0	A9-S	47W600-114	Holdup Gas Stripper Pmps	01	47W479-1	With 0-L-498 and 1-L-17; inlet pressure gage drain valved
2-L-022	676.0	A9-V	47W600-093	RHR Pmps B-B	01	47W479-1	
2-L-024	737.0	A10-W	47W600-131	Comp Cool Bstr Pmp AA & BB Pnl	01	47W479-7	
2-L-027	737.0	A10-T	47W600-114	Letdown Heat Exchanger Pnl	01	47W479-7	
2-L-042A	713.0	A12-V	47W600-154	Boron Injection Pnl			
2-L-042B	713.0	A12-V	47W600-154	Boron Injection Pnl	01	47W479-6	With 2-L-348A/B and 2-L-554
2-L-043	713.0	A13-V	47W600-115	Volume Cntl Tk Pnl			
2-L-046	713.0	A10-T	47W600-115	Seal Wtr Heat Exch Pnl	01	47W479-6	With 2-L-349A/B
2-L-047	713.0	A12-T	47W600-174	RCS System Pnl			Electrical; no drain
2-L-048	713.0	A15-S	47W600-034	Component Cooling Pump 2A-A Panel			Not located; not where shown
2-L-055A	713.0	A9-V	47W600-164	Containment Spray Heat Exch Pnl B	01	47W479-6	
2-L-055B	713.0	A9-V	47W600-164	Containment Spray Heat Exch Pnl B			
2-L-057	713.0	A15-T	47W600-034	Component Cooling Pump 2B-B Panel	01	47W479-5	Into floor drain collector tank
2-L-060A	713.0	A6-R	47W600-115	Spent Fuel Pit Demin & Filt Pnl	01	47W479-6	With 0-L-51, 0-L-388, and 1-L-60A/B
2-L-060B	713.0	A6-R	47W600-115	Spent Fuel Pit Demin & Filt Pnl			
2-L-061	692.0	A12-U	47W600-167	Charging Pump 2B & 2C Panel			Not located; not where shown
2-L-062	716.0	Az 90	47W600-172	RCS Sys Pnl			Drains manifolded into crane wall at Az 70°
2-L-063	716.0	Az 122	47W600-172	RCS Sys Pnl			Drains manifolded into crane wall at Az 70°
2-L-064	716.0	Az 78	47W600-172	RCS Sys Pnl			Drains manifolded into crane wall at Az 70°
2-L-089	716.0	Az 274	47W600-272	Cntmt Sump Lvl Transmitter Panel			Not located; not where shown

* Connection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-091	716.0	Az 172	47W600-316	RCS Wide Range Press Pnl	D1	47W476-2	With 2-L-182D
2-L-101	716.0	Az 71	47W600-272	Cntmt Sump Level Panel			Capillaries and electrical; no drains
2-L-107	692.0	A10-V	47W600-163	Safety Inj Pmps Pnl	D1	47W479-3	With 2-L-136
2-L-108A	692.0	A13-U	47W600-082	Primary Makeup Wtr & Monitor Tk Pnl	D1	47W479-3	With 2-L-137
2-L-108B	692.0	A13-U	47W600-082	Primary Makeup Wtr & Monitor Tk Pnl			
2-L-112A	692.0	A11-T	47W600-118	Charging Pmp 2B & 2C Pnl	D1	47W479-3	With 2-L-335
2-L-112B	692.0	A11-T	47W600-118	Charging Pmp 2B & 2C Pnl			
2-L-134	702.8	Az 104	47W600-044	Press Tk Level Pnl			Capillaries and electrical; no drains
2-L-135	713.0	A14-Q	47W600-117	Boric Acid Filter Pnl			Capillaries and electrical; no drains
2-L-136	692.0	A10-V	47W600-174	Safety Inj Pmp 2A & 2B Pnl	D1	47W479-3	With 2-L-107
2-L-137	692.0	A13-U	47W600-187	Cent Chg Pmp Response Time Test Pnl	D1	47W479-3	With 2-L-108A/B
2-L-140	676.0	A11-U	47W600-144	Passive RB Sump Lvl Pnl			Capillaries; no drain
2-L-141	713.0	A13-U	47W600-043	Boric Acid To Blender Pnl			Electrical; no drain
2-L-150	692.0	A6-S	47W600-181	CVCS Holdup Tk Pnl			Capillaries; no drain
2-L-153	713.0	A11-T	47W600-117	CVCS Demin and Filt Pnl	D1	47W479-6	
2-L-170A	716.0	Az 50	47W600-142	Accum No 1 Pnl	D1	47W476-2	Under construction; with 2-L-574
2-L-170B	716.0	Az 40	47W600-142	Accum No 1 Pnl			
2-L-170C	716.0	Az 40	47W600-142	Accum No 1 Pnl			
2-L-171	716.0	Az 50	47W600-142	Accum No 1 Pnl			
2-L-172A	716.0	Az 130	47W600-142	Accum No 2 Pnl	D1	47W476-2	With 2-L-599
2-L-172B	716.0	Az 138.2	47W600-142	Accum No 2 Pnl			
2-L-172C	716.0	Az 140.5	47W600-142	Accum No 2 Pnl			Under construction
2-L-173	716.0	Az 130	47W600-142	Accum No 2 Pnl			Capillaries and electrical; no drain

* Connection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-174	716.0	Az 234	47W600-032	Accum No 3 Pnl	01	47W476-2	With 2-L-191B
2-L-175A	716.0	Az 214	47W600-032	Accum No 3 Pnl	01	47W476-2	
2-L-175B	716.0	Az 214	47W600-032	Accum No 3 Pnl			Under construction
2-L-175C	716.0	Az 225	47W600-032	Accum No 3 Pnl			Under construction
2-L-176	716.0	Az 304	47W600-032	Accum No 4 Pnl	01	47W476-2	With 2-L-185B/C
2-L-177	716.0	Az 304	47W600-032	Accum No 4 Pnl			Under construction
2-L-179	716.0	Az 98	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 70°
2-L-180	716.0	Az 113	47W600-317	RCS Sys Pnl			Not located; not where shown
2-L-181	702.8	Az 75	47W600-044	RCS Sys Pnl	01	47W476-2	
2-L-182A	716.0	Az 180	47W600-308	RC Stm & Fw Safety Set I Pnl	)		
2-L-182B	716.0	Az 180	47W600-308	RC Stm & Fw Safety Set I Pnl	)		Valved
2-L-182C	716.0	Az 180	47W600-308	RC Stm & Fw Safety Set I Pnl	)		
2-L-182D	716.0	Az 170	47W600-308	RC Stm & Fw Safety Set I Pnl	01	47W476-2	With 2-L-91
2-L-183A	716.0	Az 0	47W600-309	RC Stm & Fw Safety Set II Pnl	)01	47W476-2	With 2-L-183D, 2-L-358, 2-L-360, and 2-L-361
2-L-183B	716.0	Az 0	47W600-309	RC Stm & Fw Safety Set II Pnl	)		
2-L-183C	716.0	Az 0	47W600-309	RC Stm & Fw Safety Set II Pnl			Valved
2-L-183D	716.0	Az 0	47W600-309	RC Stm & Fw Safety Set II Pnl	01	47W476-2	With 2-L-359
2-L-183E	716.0	Az 357	47W600-309	RC Stm & Fw Safety Set II Pnl			Capillaries; no drain
2-L-185A	716.0	Az 284	47W600-310	RC Stm & Fw Safety Set IV Pnl			Under construction
2-L-185B	716.0	Az 291	47W600-310	RC Stm & Fw Safety Set IV Pnl	)01	47W476-2	With 2-L-176
2-L-185C	716.0	Az 284	47W600-310	RC Stm & Fw Safety Set IV Pnl	)		
2-L-187	702.8	Az 247	47W600-088	Reac Bldg Floor & Equip Dr Sump Pnl			Into floor drain at Az 299°

* [illegible]ection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-190	702.8	Az 289	47W600-166	Wst Disp Sys Pnl	D1	47W476-2	
2-L-191A	716.0	Az 238	47W600-312	RC SIS & Fw Pnl			Valved
2-L-191B	716.0	Az 238	47W600-312	RC SIS & Fw Pnl	D1	47W476-2	With 2-L-174
2-L-203	737.0	A12-W	47W625-9	Gross Failed Fuel Det Pnl			No drain
2-L-207	713.0	A11-V	47W600-118	Volume Control Tk Pnl			Capillaries; no drain
2-L-226	702.8	Az 168.7	47W600-307	Reactor Coolant Flow Panel	)		
2-L-227	702.8	Az 157	47W600-307	Reactor Coolant Flow Panel	)		Into floor drain at Az 169°
2-L-228	702.8	Az 145	47W600-307	Reactor Coolant Flow Panel	)		
2-L-231	713.0	A11-W	47W625-1	Hot Sample Room Cubicle 2A	D1	47W479-6	With 0-L-206
2-L-232	713.0	A10-W	47W625-2	Hot Sample Room Cubicle 2B	D1	47W479-5	Into floor drain collector tank
2-L-263	702.8	Az 304	47W600-311	RCP Loop 4 Flow Sw Pnl			Into floor drain at Az 299°
2-L-264	702.8	Az 125.5	47W600-290	RCP Loop 2 & 3 Flow Sw Pnl			Into floor drain at Az 145°
2-L-268	713.0	A12-V	47W600-118	Vol Cntl Tk Pnl			Capillaries and electrical; no drain
2-L-271	702.8	Az 40	47W600-311	RCP Loop 1 Flow Sw Pnl			Into floor drain at Az 342°
2-L-284	716.0	Az 87	47W600-317	RCS Sys Pnl			Capillaries; no drain
2-L-285	716.0	Az 91	47W600-317	RCS Sys Pnl			Drains down into crane wall at Az 70°
2-L-287	676.0	A10-T	47W600-132	Cntmt Spray Htr B Pnl			No drain
2-L-288	676.0	A9-U	47W600-132	Cntmt Spray Htr A Pnl	D1	47W479-1	With 2-L-15
2-L-290	737.0	A11-W	47W600-132	Thrm Barrier Flow Trans B Pnl			Valved
2-L-292	692.0	A11-W	47W600-325	Thrm Barrier Sup Hdr Flow Xmtr B Pnl			Valved
2-L-301	713.0	A13-R	47W600-128	Boric Acid Tk B Pnl			Capillaries and electrical; no drain

* Connection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-303	713.0	A13-Q	47W600-128	Boric Acid Tk B Pnl			Capillaries and electrical; no drain
2-L-304	713.0	A13-Q	47W600-128	Boric Acid Tk B Pnl			Capillaries and electrical; no drain
2-L-328	716.0	Az 95.3	47W600-317	RCS Sys Pnl			Drains down into crane wall at Az 70°
2-L-330	716.0	Az 102	47W600-172	RCS Sys Pnl			Drains down into crane wall at Az 70°
2-L-335	692.0	A11-S	47W600-163	Component Cool Pnl	D1	47W479-3	With 2-L-112A/B
2-L-340	713.0	A12-V	47W600-314	RVLIS II Pnl			Under construction
2-L-346	713.0	A11-W	47W600-143	Boron Inj Tk Pnl			Under construction
2-L-347	713.0	A11-W	47W600-143	Boron Ink Tk Pnl			Capillaries and electrial; no drain
2-L-348A 2-L-348B	713.0 713.0	A12-V A12-V	47W600-181 47W600-181	Seal Water Flow Pnl Seal Water Flow Pnl	D1	47W479-6	With 2-L-42A/B, 2-L-43, and 2-L-554
2-L-349A 2-L-349B	713.0 713.0	A10-T A10-T	47W600-134 47W600-134	Seal Water Htx Pnl seal Water Htx Pnl	D1	47W479-6	With 2-L-46
2-L-353	713.0	A13-T	47W600-288	Letdn Demineralizer Flow Pnl	D1	47W479-6	With 2-L-558
2-L-358	716.0	Az 341	47W600-064	RCS Sys Pnl	D1	47W476-2	With 2-L-183A/B, 2-L-360, and 2-L-361
2-L-359	716.0	Az 10.8	47W600-064	RCS Sys Pnl	D1	47W476-2	With 2-L-183D
2-L-360 2-L-361	716.0 716.0	Az 336 Az 330	47W600-075 47W600-075	RCS Sys Pnl RCS Sys Pnl	D1	47W476-2	With 2-L-183A/B and 2-L-358
2-L-366	702.8	Az 104	47W600-044	RCS Press Relief Tk Pnl			Capilliaries and electrical; no drain
2-L-369	692.0	A9-U	47W600-156	RCS Sys Pnl	D1	47W479-3	
2-L-374A	733.0	A11-U	47W600-157	CVCS Sys Pnl			Capilliaries; no drain
2-L-374B	733.0	A11-U	47W600-157	CVCS Sys Pnl			Electrical; no drain
2-L-387	692.0	A13-S	47W600-318	Evap Inlet Steam Flow Pnl			No drain

*[illegible]ection detail per Drawing 47W479-1
3[illegible]4 (12/24/87)

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-388	713.0	A12-V	47W600-314	RVLIS 1 Pnl			Electrical; no drain
2-L-393	713.0	A10-W	47W625-7	Boron Analyzer Instr Panel	D1	47W479-6	In hot sample room
2-L-430	692.0	A13-R	47W600-318	Vent Cond Comp Control Pnl			No drain
2-L-446	782.0	A13-V	47W600-136	Reac Cool Flow Modifier Pnl			Not located; not where shown
2-L-447	782.0	A13-V	47W600-136	Reac Cool Flow Modifier Pnl			Not located; not where shown
2-L-472	692.0	A12-W	47W600-136	Boron Injection Pnl			Not located; not where shown
2-L-475	702.8	Az 321	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		
2-L-476	702.8	Az 337	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		
2-L-477	702.8	Az 348.7	47W600-307	Reactor Coolant Flow Panel (SG-4)	)		Into floor drain at Az 342°
2-L-478	702.8	Az 23	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		
2-L-479	702.8	Az 34	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		
2-L-480	702.8	Az 39	47W600-307	Reactor Coolant Flow Panel (SG-1)	)		
2-L-485	692.0	A13-S	47W600-318	30 GPM Boric Acid Evap Pnl			No drain
2-L-501	702.8	Az 219	47W600-307	Reactor Coolant Flow Panel (SG-3)			Into floor drain at Az 219°
2-L-502	702.8	Az 214	47W600-307	Reactor Coolant Flow Panel (SG-3)	)		Into floor drain at Az 190°
2-L-503	702.8	Az 203	47W600-307	Reactor Coolant Flow Panel (SG-3)	)		
2-L-554	713.0	A12-V	47W600-124	SIS Test Header Press Pnl	D1	47W479-6	With 2-L-42A/B, 2-L-43, and 2-L-348A/B
2-L-556	713.0	A12-V	47W600-186	PMW to BA Blender Flow Pnl			Electrical; no drain
2-L-558	713.0	A13-U	47W600-129	Pri Wtr to Demin Flow Pnl	D1	47W479-6	With 2-L-353
2-L-559	702.8	Az 140	47W600-290	RCP Loop 2 & 3 Return Flow Pnl			Into floor drain at Az 145°
2-L-560	702.8	Az 38.5	47W600-311	RCP Loop 1 Return Flow Pnl			Into floor drain at Az 342°
2-L-561	702.8	Az 303	47W600-311	RCP Loop 4 Return Flow Pnl			Into floor drain at Az 299°
2-L-574	716.0	Az 36.5	47W600-316	RC, Stm, & Fw Pnl	D1	47W476-2	With 2-L-170A/B/C and 2-L-171

* Connection detail per Drawing 47W479-1

PANEL	ELEV	AREA	PANEL DWG	PANEL DESCRIPTION	CONN DTL*	DRAIN DWG	REMARKS
2-L-598	702.8	Az 123.2	47W600-316	RC, Steam and Feedwater Panel (Inside Cntmt)			Into floor drain at Az 145°
2-L-599	716.0	Az 128	47W600-316	RC, Stm, & Fw Pnl	D1	47W476-2	With 2-L-172A/B

*[illegible]nection detail per Drawing 47W479-1
[illegible]4 (12/24/87)

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-001	519.0	R02-n	D61	Core Spray System I Panel	47W476-1	Equipment	
2-25-001	519.0	R09-n	D61	Core Spray System I Panel	47W476-2	Equipment	With 2-25-21, 2-25-225A
3-25-001	519.0	R16-n	D61	Core Spray System I Panel	47W476-3	Equipment	With 3-25-21
1-25-002	593.0	R05-s	A58	Reactor Water Cleanup System Panel	47W481-7	Equipment	
2-25-002	593.0	R10-s	A58	Reactor Water Cleanup System Panel	47W481-7	Equipment	With 2-25-5A/D, 2-25-5-1
3-25-002	593.0	R17-s	A58	Reactor Water Cleanup System Panel	47W481-7	Equipment	
1-25-003	621.25	R06-s	B96	Reactor Water Cleanup Demin Panel			Electrical; no drain
2-25-003	621.25	R09-s	B96	Reactor Water Cleanup Demin Panel			Electrical; no drain
3-25-003	621.25	R16-s	B96	Reactor Water Cleanup Demin Panel			Electrical; no drain
1-25-004	565.0	R06-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
2-25-004	565.0	R13-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
3-25-004	565.0	R20-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
1-25-005A	593.0	R03-s	B58	Reactor Protection & NSS Syst Panel)			
1-25-005B	593.0	R03-s	B58	Reactor Protection & NSS Syst Panel)			
1-25-005C	593.0	R03-s	A301	Reactor Protection & NSS Syst Panel)	47W481-7	Equipment	No instruments on 1-25-5C
1-25-005D	593.0	R03-s	A301	Reactor Protection & NSS Syst Panel)			
1-25-005-1	593.0	R03-s	A135	Reactor Protection Panel)			
2-25-005A	593.0	R10-s	B58	Reactor Protection & NSS Syst Panel)			
2-25-005B	593.0	R10-s	B58	Reactor Protection & NSS Syst Panel)			
2-25-005C	593.0	R10-s	A301	Reactor Protection & NSS Syst Panel)	47W481-7	Equipment	With 2-25-2
2-25-005D	593.0	R10-s	A301	Reactor Protection & NSS Syst Panel)			
2-25-005-1	593.0	R10-t	A135	Reactor Protection Panel)			
3-25-005A	593.0	R17-s	B58	Reactor Protection & NSS Syst Panel)	47W481-7	Equipment	With 3-25-5-1
3-25-005B	593.0	R17-s	B58	Reactor Protection & NSS Syst Panel)			
3-25-005C	593.0	R17-s	A301	Reactor Protection & NSS Syst Panel)			Not found; not where shown
3-25-005D	593.0	R17-s	A301	Reactor Protection & NSS Syst Panel)			
3-25-005-1	593.0	R17-t	A135	Reactor Protection Panel	47W481-7	Equipment	With 3-25-5A/B

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-006A	593.0	R05-p	B57	Reactor Vessel Level & Press Panel			
1-25-006B	593.0	R05-p	B57	Reactor Vessel Level & Press Panel	47W481-7	Equipment	
1-25-006C	593.0	R06-p	A302	Reactor Protection & NSS Syst Panel			
1-25-006D	593.0	R06-p	A302	Reactor Protection & NSS Syst Panel			No instruments on 1-25-6D
1-25-006-1	593.0	R05-q	B135	Reactor Protection Panel	47W481-7	Equipment	
2-25-006A	593.0	R12-p	B57	Reactor Vessel Level & Press Panel	47W481-7	Equipment	
2-25-006B	593.0	R12-p	B57	Reactor Vessel Level & Press Panel			
2-25-006C	593.0	R12-q	A302	Reactor Protection & NSS Syst Panel			
2-25-006D	593.0	R12-q	A302	Reactor Protection & NSS Syst Panel	47W481-7	Equipment	
2-25-006-1	593.0	R12-p	B135	Reactor Protection Panel			
3-25-006A	593.0	R19-p	B57	Reactor Vessel Level & Press Panel	47W481-7	Equipment	
3-25-006B	593.0	R19-p	B57	Reactor Vessel Level & Press Panel			
3-25-006C	593.0	R19-q	A302	Reactor Protection & NSS Syst Panel			Not found; not where shown
3-25-006D	593.0	R19-q	A302	Reactor Protection & NSS Syst Panel			Not found; not where shown
3-25-006-1	593.0	R19-p	B135	Reactor Protection Panel			Drains down thru floor sleeve; not traceable
1-25-007A	541.5	R01-t	B59	Recirc System Panel	47W476-1	Floor	With 1-25-59, 1-25-63
1-25-007B	541.5	R01-t	B59	Recirc System Panel			
2-25-007A	541.5	R08-t	B59	Recirc System Panel	47W476-2	Floor	With 2-25-59
2-25-007B	541.5	R08-t	B59	Recirc System Panel			
3-25-007A	541.5	R15-t	B59	Recirc System Panel	47W476-3	Floor	With 3-25-59
3-25-007B	541.5	R15-t	B59	Recirc System Panel			
0-25-010A	565.0	W05-c	A86	Precoat & Backwash Panel			Capped
0-25-010B	565.0	W05-c	A86	Precoat & Backwash Panel			Electrical; no drain
0-25-011	565.0	W04-d	B71	Waste Demineralizer Panel			Drains down into chem waste tank at El 546.0
0-25-013	546.0	W01-a	A99	Waste Pkg Drain Tank Panel			Valved
1-25-015	621.25	R03-s	B56	Fuel Pool Panel			Electrical; no drain
2-25-015	621.25	R12-s	B56	Fuel Pool Panel			Electrical; no drain

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
3-25-015	621.25	R19-s	B56	Fuel Pool Panel			Electrical; no drain
1-25-016	621.25	R05-s	C56	Fuel Pool Pump Panel			Manifolded; capped and valved
2-25-016	621.25	R10-s	C56	Fuel Pool Pump Panel			Manifolded; plugged and valved
3-25-016	621.25	R17-s	C56	Fuel Pool Pump Panel			Manifolded; capped
0-25-017	565.0	W06-c	Key A101	Main Radwaste Control Panel			Electrical; no drain
1-25-018A	565.0	R05-n	B62	CRD Hydraulic System Panel)	47W481-9	Equipment	
1-25-018B	565.0	R05-n	B62	CRD Hydraulic System Panel)			
2-25-018A	565.0	R12-n	B62	CRD Hydraulic System Panel)	47W481-9	Equipment	
2-25-018B	565.0	R12-n	B62	CRD Hydraulic System Panel)			
3-25-018A	565.0	R19-n	B62	CRD Hydraulic System Panel)	47W481-9	Equipment	
3-25-018B	565.0	R19-n	B62	CRD Hydraulic System Panel)			
0-25-020A	565.0	W01-f	A71	Cond & Clnup Phase Separator Panel			Two manifolds; each capped and valved
0-25-020B	565.0	W02-b	A71	Cond & Clnup Phase Separator Panel)			Manifolded; capped and valved
0-25-020C	565.0	W02-b	A71	Cond & Clnup Phase Separator Panel)			
1-25-021	541.5	R07-n	A23	CRD Pump Panel	47W476-1	Equipment	With 1-25-60, 1-25-81, 1-25-225B
2-25-021	541.5	R14-n	A23	CRD Pump Panel	47W476-2	Equipment	With 2-25-1, 2-25-225A
3-25-021	541.5	R21-n	A23	CRD Pump Panel	47W476-3	Equipment	With 3-25-1
1-25-022	565.0	R02-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
2-25-022	565.0	R09-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
3-25-022	565.0	R16-p	Key E101	CRD Accum Mon & Scram Valve Sel Panel			Electrical; no drain
1-25-025A	565.0	R06-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025B	565.0	R06-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025C	565.0	R06-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025D	565.0	R06-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025E	565.0	R02-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025F	565.0	R02-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-025G	565.0	R02-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain

TABLE 1B
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-025H	565.0	R02-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025A	565.0	R13-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025B	565.0	R13-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025C	565.0	R13-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025D	565.0	R13-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025E	565.0	R09-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025F	565.0	R09-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025G	565.0	R09-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain
2-25-025H	565.0	R09-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025A	565.0	R20-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025B	565.0	R20-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025C	565.0	R20-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025D	565.0	R20-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025E	565.0	R16-s	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025F	565.0	R16-r	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025G	565.0	R16-q	Key E101	Scram Valve Fuse Panel			Electrical; no drain
3-25-025H	565.0	R16-p	Key E101	Scram Valve Fuse Panel			Electrical; no drain
1-25-031	621.25	R02-q	Key B101	RCIC Backup Control Panel			Electrical; no drain
2-25-031	621.25	R13-q	Key B101	RCIC Backup Control Panel			Electrical; no drain
3-25-031	621.25	R20-q	Key B101	RCIC Backup Control Panel			Electrical; no drain
1-25-032	621.25	R02-q	Key B101	Backup Control Center Panel			Electrical; no drain
2-25-032	621.25	R13-q	Key B101	Backup Control Center Panel			Electrical; no drain
3-25-032	621.25	R20-q	Key B101	Backup Control Center Panel			Electrical; no drain
1-25-033	519.0	R01-r	Key G101	Suppression Pool Inst No. 1 Panel			Not found; not where shown
2-25-033	519.0	R08-r	Key G101	Suppression Pool Inst No. 1 Panel			Not found; not where shown
3-25-033	519.0	R15-r	Key G101	Suppression Pool Inst No. 1 Panel			Not found; not where shown
1-25-034	519.0	R07-r	B101	Suppression Pool Inst No. 2 Panel			Valved

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
2-25-034	519.0	R14-r	B101	Suppression Pool Inst No. 2 Panel			Valved
3-25-034	519.0	R21-r	B101	Suppression Pool Inst No. 2 Panel			Valved
0-25-035A	565.0	W03-f	A93	Fuel Pool Demineralizer Vessel Panel)			
0-25-035B	565.0	W03-f	A93	Fuel Pool Demineralizer Vessel Panel)	47W560-4	Equipment	
0-25-035C	565.0	W03-e	A93	Fuel Pool Demineralizer Vessel Panel)			
0-25-035D	565.0	W03-e	A93	Fuel Pool Demineralizer Vessel Panel)			
1-25-036A	621.25	R06-s	A96	Reactor Water Cleanup Demin Panel)			Manifolded; capped and valved
1-25-036B	621.25	R06-s	A96	Reactor Water Cleanup Demin Panel)			
2-25-036A	621.25	R09-s	A96	Reactor Water Cleanup Demin Panel)	47W481-5	Equipment	
2-25-036B	621.25	R09-s	A96	Reactor Water Cleanup Demin Panel)			
3-25-036A	621.25	R16-s	A96	Reactor Water Cleanup Demin Panel)	47W481-5	Equipment	With 3-25-187
3-25-036B	621.25	R16-s	A96	Reactor Water Cleanup Demin Panel)			
1-25-037	639.0	R05-q	A101	Fuel Pool Skimmer Surge Tank Panel			Valved
2-25-037	639.0	R10-q	A101	Fuel Pool Skimmer Surge Tank Panel			Valved
3-25-037	639.0	R17-q	A101	Fuel Pool Skimmer Surge Tank Panel			Valved
1-25-050	519.0	R01-u	A61	HPCI Pump Panel	47W476-1	Equipment	
2-25-050	519.0	R14-u	A61	HPCI Pump Panel	47W476-2	Equipment	With 2-25-63
3-25-050	519.0	R21-u	A61	HPCI Pump Panel			Manifolded with 3-25-63; plugged and open
1-25-051A	565.0	R03-p	D60	No.1 Jet Pump Inst Panel)	47W481-9	Equipment	
1-25-051B	565.0	R03-p	D60	No.1 Jet Pump Inst Panel)			
2-25-051A	565.0	R10-p	D60	No.1 Jet Pump Inst Panel)	47W481-9	Equipment	
2-25-051B	565.0	R10-p	D60	No.1 Jet Pump Inst Panel)			
3-25-051A	565.0	R17-p	D60	No.1 Jet Pump Inst Panel)	47W481-9	Equipment	
3-25-051B	565.0	R17-p	D60	No.1 Jet Pump Inst Panel)			
1-25-052A	565.0	R05-q	B60	No.2 Jet Pump Inst Panel)	47W481-9	Equipment	
1-25-052B	565.0	R05-q	B60	No.2 Jet Pump Inst Panel)			

TABLE 1B
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
2-25-052A	565.0	R12-q	B60	No.2 Jet Pump Inst Panel)	47W481-9	Equipment	
2-25-052B	565.0	R12-q	B60	No.2 Jet Pump Inst Panel)			
3-25-052A	565.0	R19-q	B60	No.2 Jet Pump Inst Panel)	47W481-9	Equipment	
3-25-052B	565.0	R19-q	B60	No.2 Jet Pump Inst Panel)			
0-25-055A	568.0	Stack	A56	Offgas Filter Panel			Valved
0-25-055B	568.0	Stack	A56	Offgas Filter Panel			Valved
0-25-055C	568.0	Stack	A56	Offgas Filter Panel			Valved
1-25-056A	541.5	R07-p	B23	Main Steam Panel)	47W476-1	Equipment	
1-25-056B	541.5	R07-p	B23	Main Steam Panel)			
2-25-056A	541.5	R14-p	B23	Main Steam Panel)	47W476-2	Equipment	
2-25-056B	541.5	R14-p	B23	Main Steam Panel)			
3-25-056A	541.5	R21-p	B23	Main Steam Panel)	47W476-3	Equipment	
3-25-056B	541.5	R21-p	B23	Main Steam Panel)			
1-25-057A	565.0	R03-s	A59	Recirc,Core Spray, Pri Cont Panel)	47W481-9	Equipment	
1-25-057B	565.0	R03-s	A59	Recirc,Core Spray, Pri Cont Panel)			
2-25-057A	565.0	R10-s	A59	Recirc,Core Spray, Pri Cont Panel)	47W481-9	Equipment	
2-25-057B	565.0	R10-s	A59	Recirc,Core Spray, Pri Cont Panel)			
3-25-057A	565.0	R17-s	A59	Recirc,Core Spray, Pri Cont Panel)	47W481-9	Equipment	
3-25-057B	565.0	R17-s	A59	Recirc,Core Spray, Pri Cont Panel)			
1-25-058	519.0	R02-p	C61	RCIC System Panel	47W476-1	Floor	With 1-25-225A
2-25-058	519.0	R09-p	C61	RCIC System Panel	47W476-2	Floor	
3-25-058	519.0	R16-p	C61	RCIC System Panel	47W476-3	Floor	
1-25-059	519.0	R01-t	A62	RHR System Panel	47W476-1	Floor	With 1-25-7A/B, 1-25-63
2-25-059	519.0	R08-t	A62A	RHR System Panel	47W476-2	Floor	With 2-25-7A/B
3-25-059	519.0	R15-t	B62A	RHR System Panel	47W476-3	Floor	With 3-25-7A/B
1-25-060	519.0	R06-n	B97	Core Spray System 2 Panel	47W476-1	Equipment	With 1-25-21, 1-25-81, 1-25-225B

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
2-25-060	519.0	R13-n	B97	Core Spray System 2 Panel	47W476-2	Equipment	With 2-25-81
3-25-060	519.0	R20-n	B97	Core Spray System 2 Panel	47W476-3	Equipment	With 3-25-81
1-25-062	519.0	R07-t	A97	RHR System 2 Panel	47W476-1	Equipment	
2-25-062	519.0	R14-t	A97A	RHR System 2 Panel	47W476-2	Equipment	
3-25-062	519.0	R21-t	B97A	RHR System 2 Panel	47W476-3	Equipment	
1-25-063	519.0	R01-t	B61	HPCI System Panel	47W476-1	Floor	With 1-25-7A/B, 1-25-59
2-25-063	519.0	R14-t	B61	HPCI System Panel	47W476-2	Equipment	With 2-25-50
3-25-063	519.0	R21-t	B61	HPCI System Panel			Manifolded with 3-25-50; plugged and open
1-25-065	557.0	T05-g	A82B	Condensate Backwash Panel			Manifolded; valved
2-25-065	557.0	T07-g	A83	Condensate Backwash Panel			Valved; tubed to floor
3-25-065	557.0	T12-g	A83	Condensate Backwash Panel			Valved on front of panel
1-25-066	593.0	R06-q	C83	Cleanup Backwash Panel			Valved on panel
2-25-066	593.0	R09-q	C83	Cleanup Backwash Panel			Valved on panel
3-25-066	593.0	R16-q	C83	Cleanup Backwash Panel			Valved on panel
0-25-067	565.0	W06-c	A94	Filter Aid & Waste Precoat Tank Panel			Manifolded; valved
0-25-068	546.0	W04-b	A88	Waste, Resin & Backwash Panel	47W560-4	Floor	
0-25-069	546.0	W07-c	B94	FD Collector Pump Discharge Panel			Manifolded with tubing; open
0-25-070	546.0	W04-f	C94	Waste Collector & Surge Pump Panel			Tubed toward floor; open
0-25-071A	565.0	W03-f	B93	Fuel Pool Filter Demin Pump Panel			Manifolded with tubing; open toward floor
0-25-071B	565.0	W03-f	B93	Fuel Pool Filter Demin Pump Panel			Manifolded with tubing; open toward floor
0-25-071C	565.0	W03-f	B93	Fuel Pool Filter Demin Pump Panel			Manifolded with tubing; open toward floor
0-25-071D	565.0	W03-f	B93	Fuel Pool Filter Demin Pump Panel			Manifolded with tubing; open toward floor
0-25-072	565.0	W03-d	C93	Waste Filter Panel			Manifolded with tubing; open toward floor
0-25-073	565.0	W03-c	D93	Floor Drain Filter Panel			Manifolded with tubing; open toward floor
0-25-074	578.0	W03-b	D94	FD Sample Pump Discharge Panel			Manifolded with tubing; open
0-25-075	578.0	W03-d	E94	Waste Sample Pump Discharge Panel			Manifolded with 0-25-166; plugged and capped
0-25-076	546.0	W03-f	A92	Cond & Waste Decant Pump Panel			Valved

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
0-25-077	546.0	W02-c	B92	Cond & Waste Sludge Pump Panel			Manifolded with tubing; open
0-25-078	546.0	W04-a	E88	Laundry Control Panel			Valved
0-25-079	578.0	W02-f	C99	Waste Sample Tank A1 & A2 Panel			Valved; drain port up
0-25-080	578.0	W02-d	C99	Waste Sample Tank B1 & B2 Panel			Valved; drain port up
1-25-081	541.5	R07-n	B99	Drywell FD & Equipment Sump Panel			With 1-25-21, 1-25-60, 1-25-225B
2-25-081	541.5	R14-n	B99	Drywell FD & Equipment Sump Panel			With 2-25-60
3-25-081	541.5	R21-n	B99	Drywell FD & Equipment Sump Panel			With 3-25-60
0-25-082	546.0	W05-a	F88	Laundry Drain Pump Discharge Panel			Manifolded with tubing; open toward floor
1-25-083A	533.0	T05-h	A89	Cond Backwash Trans Pump Press Panel			No access; C-zone
2-25-083B	533.0	T07-h	A89	Cond Backwash Trans Pump Press Panel			No access; C-zone
3-25-083C	533.0	T12-h	B89	Cond Backwash Trans Pump Press Panel			Valved and piped to floor
0-25-084	546.0	W02-d	B92	Cond & Waste Sludge Pump Panel			Tubed toward floor; open
0-25-085	546.0	W04-c	D88	Waste Backwash Mix Pump Panel			Open tubing
0-25-086	546.0	W05-d	B88	Spent Resin Pump Discharge Panel			Capped
0-25-087	546.0	W04-c	C88	Chem Waste Pump Discharge Panel			Manifolded with tubing; open
0-25-088	546.0	W01-a	A99	Waste Pkg Drain Tank Panel			Manifolded with tubing; open
1-25-089A	593.0	R07-q	C89	Cleanup Backwash Transfer Pump Panel			No drain
2-25-089B	593.0	R08-q	C89	Cleanup Backwash Transfer Pump Panel			No drain
3-25-089C	593.0	R15-q	D89	Cleanup Backwash Transfer Pump Panel			No drain
0-25-090	546.0	W00-c	C92	Cleanup Decant Pump Discharge Panel			Manifolded with tubing; open toward floor
0-25-091	546.0	W00-c	D92	Cleanup Sludge Pump Discharge Panel			Tubed toward floor; open
0-25-092	546.0	W02-f	A92	Cond & Waste Decant Pump Panel			Tubed toward floor; open
1-25-095	604.0	T06-c	A124	Offgas Panel	47W478-5	Floor	
2-25-095	604.0	T06-c	A124	Offgas Panel			
3-25-095	604.0	T12-c	A124	Offgas Panel	47W478-7	Floor	
1-25-096	538.5	OGT Bldg	A125	Offgas Panel			Capillaries and electrical; no drain
2-25-096	538.5	OGT Bldg	A125	Offgas Panel			Capillaries and electrical; no drain
3-25-096	538.5	OGT Bldg	A125	Offgas Panel			Capillaries and electrical; no drain

TABLE 1B
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-097	556.25	OGT Bldg	B124	Offgas Panel	17W401-6	OGT Bldg	
2-25-097	556.25	OGT Bldg	B124	Offgas Panel	17W401-6	OGT Bldg	
3-25-097	556.25	OGT Bldg	B124	Offgas Panel	17W401-6	OGT Bldg	
1-25-100A	617.0	T05-d	A21	RFW and Steam Panel			
1-25-100B	617.0	T05-d	B87	RFW and Steam Panel	47W478-1	Equipment	
1-25-100C	617.0	T05-d	A87	RFW and Steam Panel			
2-25-100A	617.0	T07-d	A21	RFW and Steam Panel			
2-25-100B	617.0	T07-d	B87	RFW and Steam Panel	47W478-1	Equipment	
2-25-100C	617.0	T07-d	A87	RFW and Steam Panel			
3-25-100A	617.0	T13-d	A21	RFW and Steam Panel			
3-25-100B	617.0	T13-d	B87	RFW and Steam Panel			Manifolded and plugged
3-25-100C	617.0	T13-d	A87	RFW and Steam Panel			
1-25-101A	617.0	T05-g	22	RFW and Steam Panel	47W478-2	Floor	
1-25-101B	617.0	T05-g	22	RFW and Steam Panel			
2-25-101A	617.0	T07-g	22	RFW and Steam Panel	47W478-2	Floor	
2-25-101B	617.0	T07-g	22	RFW and Steam Panel			
3-25-101A	617.0	T13-g	22	RFW and Steam Panel			Manifolded; capped and open
3-25-101B	617.0	T13-g	22	RFW and Steam Panel			
1-25-102	617.0	T02-J	C24	Steam Seal Reg Panel			No drain
2-25-102	617.0	T10-J	C24	Steam Seal Reg Panel			No drain
3-25-102	617.0	T16-J	C24	Steam Seal Reg Panel			No drain
1-25-105	586.0	T06-c	A35	Moisture Separator Panel			Manifolded; upper plugged, lower capped and valved
1-25-105A	586.0	T06-c	C139	Moisture Separator Panel			Manifolded with 2-25-105A; both ends open
1-25-105B	586.0	T06-c	C139	Moisture Separator Panel			Not used
2-25-105	586.0	T06-c	A35	Moisture Separator Panel			Manifolded; upper plugged, lower capped and valved
2-25-105A	586.0	T06-c	C139	Moisture Separator Panel			Manifolded with 1-25-105A; both ends open
2-25-105B	586.0	T06-c	C139	Moisture Separator Panel			Not used

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
3-25-105	586.0	T12-c	A35	Moisture Separator Panel			Manifolded; upper plugged, lower capped and open
3-25-105A	586.0	T12-c	C139	Moisture Separator Panel			Valved
3-25-105B	586.0	T12-c	C139	Moisture Separator Panel			Not used
1-25-106A	586.0	T02-d	30	Extraction Panel	47W477-1	Floor	1-inch drain line into 1-1/2-inch standpipe
1-25-106B	586.0	T02-d	31	Extraction Panel			
2-25-106A	586.0	T10-d	30	Extraction Panel	47W477-1	Floor	
2-25-106B	586.0	T10-d	31	Extraction Panel			
3-25-106A	586.0	T16-d	30	Extraction Panel	47W477-3	Floor	
3-25-106B	586.0	T16-d	31	Extraction Panel			
1-25-107	586.0	T05-g	A32	No. A3 Heater Panel	47W477-2	Floor	Tee with riser from El. 617
2-25-107	586.0	T07-g	A32	No. A3 Heater Panel	47W477-2	Floor	Tee with riser from El. 617
3-25-107	586.0	T13-g	A32	No. A3 Heater Panel	47W477-3	Floor	Tee with cap
1-25-108	586.0	T05-f	A33	No. B3 Heater Panel	47W477-1	Floor	Tee with sample sink and riser from El. 617
2-25-108	586.0	T07-f	A33	No. B3 Heater Panel	47W477-1	Floor	Tee with sample sink and riser from El. 617
3-25-108	586.0	T13-f	A33	No. B3 Heater Panel	47W477-3	Floor	Tee with cap
1-25-109	586.0	T05-e	B32	No. C3 Heater Panel	47W477-1	Floor	Tee with sample sink
2-25-109	586.0	T07-e	B32	No. C3 Heater Panel	47W477-1	Floor	Tee with sample sink
3-25-109	586.0	T13-e	B32	No. C3 Heater Panel	47W477-3	Floor	Tee with sample sink
1-25-110	586.0	T05-h	A34	Moisture Separator Panel	47W477-2	Floor	
2-25-110	586.0	T07-h	A34	Moisture Separator Panel	47W477-2	Floor	
3-25-110	586.0	T13-h	A34	Moisture Separator Panel	47W477-3	Floor	
1-25-111	586.0	T02-j	29	Moisture Separator Panel	47W477-2	Floor	
2-25-111	586.0	T10-j	29	Moisture Separator Panel	47W477-2	Floor	
3-25-111	586.0	T16-j	29	Moisture Separator Panel	47W477-3	Floor	
1-25-112	586.0	T04-k	29	Steam Panel	47W477-2	Floor	With 1-25-113A/D and 1-25-149 (sample sink)
2-25-112	586.0	T08-k	29	Steam Panel	47W477-2	Floor	With 2-25-113A/D and 2-25-149 (sample sink)
3-25-112	586.0	T14-k	29	Steam Panel	47W477-3	Floor	With 3-25-113A/D and 3-25-149 (sample sink)

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-113A	586.0	T04-k	A25	Nos 1 and 2 Heater Panel			
1-25-113B	586.0	T04-k	26	Nos 1 and 2 Heater Panel	47W477-2	Floor	With 1-25-112 and 1-25-149 (sample sink)
1-25-113C	586.0	T04-k	27	Nos 1 and 2 Heater Panel			
1-25-113D	586.0	T04-k	28	Nos 1 and 2 Heater Panel			
2-25-113A	586.0	T08-k	A25	Nos 1 and 2 Heater Panel			
2-25-113B	586.0	T08-k	26	Nos 1 and 2 Heater Panel	47W477-2	Floor	With 2-25-112 and 2-25-149 (sample sink)
2-25-113C	586.0	T08-k	27	Nos 1 and 2 Heater Panel			
2-25-113D	586.0	T08-k	28	Nos 1 and 2 Heater Panel			
3-25-113A	586.0	T14-k	A25	Nos 1 and 2 Heater Panel			
3-25-113B	586.0	T14-k	26	Nos 1 and 2 Heater Panel	47W477-3	Floor	With 3-25-112 and 3-25-149 (sample sink)
3-25-113C	586.0	T14-k	27	Nos 1 and 2 Heater Panel			
3-25-113D	586.0	T14-k	28	Nos 1 and 2 Heater Panel			
1-25-115A	557.0	T02-d	37	Cond and Heater Drain & Vent Panel	47W479-1	Equipment	
1-25-115B	557.0	T02-d	38	Cond and Heater Drain & Vent Panel			
1-25-115C	557.0	T02-d	A39	Cond and Heater Drain & Vent Panel	47W479-1	Equipment	
1-25-115D	604.0	T02-c	B33	Condensate & Heater Drain & Vent Panel			Drains with 1-25-278 to condenser at El. 586
2-25-115A	557.0	T10-d	37	Cond and Heater Drain & Vent Panel			
2-25-115B	557.0	T10-d	38	Cond and Heater Drain & Vent Panel	47W479-1	Equipment	
2-25-115C	557.0	T10-d	A39	Cond and Heater Drain & Vent Panel			
2-25-115D	604.0	T10-c	B33	Condensate & Heater Drain & Vent Panel			Drains with 2-25-278 to condenser at El. 586
3-25-115A	573.0	T17-d	37	Cond and Heater Drain & Vent Panel			
3-25-115B	573.0	T17-d	38	Cond and Heater Drain & Vent Panel	47W479-3	Equipment	
3-25-115C	573.0	T17-d	A39	Cond and Heater Drain & Vent Panel			
3-25-115D	604.0	T16-c	B33	Condensate & Heater Drain & Vent Panel			Drains with 3-25-278 to condenser at El. 586
1-25-116A	557.0	T04-g	40	Cond, Circ Water and HD&V Panel			
1-25-116B	557.0	T04-g	41	Cond, Circ Water and HD&V Panel	47W479-2	Floor	
1-25-116C	557.0	T04-g	42	Cond, Circ Water and HD&V Panel			
2-25-116A	557.0	T08-g	40	Cond, Circ Water and HD&V Panel			

TABLE 18
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION		DRAIN DRAWING	DRAIN SUMP	REMARKS
2-25-116B	557.0	T08-g	41	Cond, Circ Water and HD&V Panel	)	47W479-2	Floor	
2-25-116C	557.0	T08-g	42	Cond, Circ Water and HD&V Panel	)			
3-25-116A	557.0	T14-g	40	Cond, Circ Water and HD&V Panel	)			
3-25-116B	557.0	T14-g	41	Cond, Circ Water and HD&V Panel	)	47W479-4	Station	
3-25-116C	557.0	T14-g	42	Cond, Circ Water and HD&V Panel	)			
1-25-117A	565.0	T02-h	A63	Moisture Separator Panel	)			
1-25-117B	565.0	T02-h	A64	Moisture Separator Panel	)	47W479-2	Equipment	
1-25-117C	565.0	T02-h	A115	Moisture Separator Panel	)			
2-25-117A	565.0	T09-h	A63	Moisture Separator Panel	)			
2-25-117B	565.0	T09-h	A64	Moisture Separator Panel	)	47W479-2	Floor	
2-25-117C	565.0	T10-h	A115	Moisture Separator Panel	)			
3-25-117A	565.0	T15-h	A63	Moisture Separator Panel	)	47W479-4	Floor	
3-25-117B	565.0	T15-h	A64	Moisture Separator Panel	)			
3-25-117C	565.0	T16-h	A115	Moisture Separator Panel				Manifolded; valved near floor
1-25-120	586.0	T02-k	B24	Initial Pressure Reg Panel				Capped tube tee
2-25-120	586.0	T10-k	B24	Initial Pressure Reg Panel				No drain
3-25-120	586.0	T16-k	B24	Initial Pressure Reg Panel				Capped tube tee
1-25-121	557.0	T05-j	A95	Condensate Demineralizer Panel				Manifolded; valved
2-25-121	557.0	T07-j	A95	Condensate Demineralizer Panel				Manifolded; valved
3-25-121	557.0	T13-j	A95	Condensate Demineralizer Panel				Manifolded; valved
1-25-122	557.0	T05-c	A36	Condensate Booster Pump Panel		47W479-1	Equipment	With 1-25-335 and 2-25-325
2-25-122	557.0	T07-c	A36	Condensate Booster Pump Panel				Manifolded; valved
3-25-122	557.0	T13-c	A36	Condensate Booster Pump Panel		47W479-3	Equipment	1-inch pipe into 2-inch flush standpipe
1-25-126	565.0	T02-k	43A	Feedwater Panel		47W479-2	Station	
2-25-126	565.0	T08-k	43A	Feedwater Panel				Valved
3-25-126	565.0	T14-k	43A	Feedwater Panel		47W479-4	Floor	

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-127	565.0	T04-j	43B	Feedwater Panel	47W479-2	Floor	
2-25-127	565.0	T10-j	43B	Feedwater Panel	47W479-2	Floor	
3-25-127	565.0	T16-j	43B	Feedwater Panel	47W479-4	Floor	
1-25-130	557.0	T06-d	43C	Condensate Drain Tank Panel)			
2-25-130	557.0	T06-d	43C	Condensate Drain Tank Panel)			Manifolded; valved near floor
3-25-130	557.0	T12-d	43C	Condensate Drain Tank Panel			Manifolded; open
1-25-131	586.0	T02-j	A24	Intermediate Pressure Reg Panel			Valved at panel
2-25-131	586.0	T10-j	A24	Intermediate Pressure Reg Panel			Valved at panel
3-25-131	586.0	T16-j	A24	Intermediate Pressure Reg Panel			Valved at panel
0-25-144	576.5	Yard	B53	Demin Water Storage Tank Panel			Valved drain inside cabinet
0-25-145	576.5	Yard	A53	Cond Water Storage Tank 3 Panel			Valved drain inside cabinet
0-25-146	576.5	Yard	A53	Cond Water Storage Tank 2 Panel			Valved drain inside cabinet
0-25-147	576.5	Yard	A53	Cond Water Storage Tank 1 Panel			Valved drain inside cabinet
1-25-150	557.0	T05-g	A82	Condensate Precoat Panel			Manifolded and valved
2-25-150	557.0	T07-g	A82	Condensate Precoat Panel			Manifolded and valved
3-25-150	557.0	T13-g	A82	Condensate Precoat Panel			Manifolded and capped
1-25-151A	557.0	T06-g	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151B	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151C	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151D	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151E	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151F	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151G	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151H	557.0	T06-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-151J	557.0	T06-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151A	557.0	T06-g	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151B	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
2-25-151C	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151D	557.0	T06-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151E	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151F	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151G	557.0	T06-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151H	557.0	T06-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
2-25-151J	557.0	T06-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower soft plugged and open
3-25-151A	557.0	T13-g	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151B	557.0	T13-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151C	557.0	T13-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151D	557.0	T13-f	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151E	557.0	T13-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151F	557.0	T13-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151G	557.0	T13-e	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151H	557.0	T13-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
3-25-151J	557.0	T13-d	B82	Condensate Demineralizer Panel			Manifolded; upper plugged, lower capped and valved
1-25-152	557.0	T05-d	A83	Condensate Demin Common Panel			Manifolded, capped and valved
2-25-152	557.0	T07-d	A83	Condensate Demin Common Panel			Manifolded; soft plugged and open
3-25-152	557.0	T12-d	A83	Condensate Demin Common Panel			Manifolded; capped and valved
1-25-160	519.0	R04-u	Key C112	RHR System II Water Tight Panel			Valved
2-25-160	519.0	R11-u	Key C112	RHR System II Water Tight Panel			No access; high radiation level
3-25-160	519.0	R18-u	Key C112	RHR System II Water Tight Panel			Valved
0-25-161	565.0	W03-d	A65	FD & Waste Filter CV Panel			Manifolded; plugged
0-25-162	546.0	W07-c	A66	FD Collector CV Panel			Manifolded; plugged
0-25-164	565.0	W04-d	A67	Waste Demineralizer CV Panel			Manifolded; plugged
0-25-166	578.0	W03-d	A68	Waste Sample CV Panel			Manifolded with 0-25-75; plugged and capped

TABLE 1B
BFN HOT INSTRUMENT PANEL TABULATION

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
0-25-167	546.0	W01-c	B68	Cleanup Phase Separator CV Panel			Manifolded; plugged
0-25-168A	546.0	W02-c	A69	Cond Phase Separator CV Panel			Manifolded; plugged
0-25-168B	546.0	W02-c	A70	Cond Phase Separator DV Panel			Manifolded; plugged
0-25-169	546.0	W04-b	A73	Spent Resin, Chem Waste, etc CV Panel			Manifolded; plugged
0-25-170	546.0	W04-a	B73	Laundry System CV Panel			Manifolded; plugged
0-25-171A	565.0	W01-a	A74	Waste Package CV Panel			Manifolded; plugged
0-25-171B	565.0	W01-a	A74	Waste Package CV Panel			Manifolded; plugged
1-25-172	593.0	R06-q	A75	Cleanup Backwash CV Panel			Manifolded; plugged
2-25-172	593.0	R09-q	A75	Cleanup Backwash CV Panel			Manifolded; plugged
3-25-172	593.0	R16-q	A75	Cleanup Backwash CV Panel.			No drain
1-25-173	557.0	T05-g	B75	Condensate Backwash CV Panel			Manifolded; plugged
2-25-173	557.0	T07-g	B75	Condensate Backwash CV Panel			Manifolded; plugged
3-25-173	557.0	T13-g	B75	Condensate Backwash CV Panel			No drain
0-25-174	546.0	W01-b	B86	Waste Package CV Panel			Manifolded; plugged
0-25-175	546.0	W04-f	B66	Waste Collector and Surge CV Panel			Manifolded; plugged
0-25-176	578.0	W01-c	D127	Waste Package Vacuum Tank Panel			Valved
1-25-177	565.0	R05-p	D118	Drywell Sump Level Panel			Electrical; no drain
2-25-177	565.0	R12-p	D118	Drywell Sump Level Panel			Electrical; no drain
3-25-177	565.0	R19-p	D118	Drywell Sump Level Panel			Electrical; no drain
0-25-186	546.0	W05-c	A118	Chem Waste Tank Panel			Valved
1-25-187	621.25	R06-s	A112	Reactor Water Cleanup Panel	47W481-5	Equipment	
2-25-187	621.25	R09-s	A112	Reactor Water Cleanup Panel	47W481-5	Equipment	
3-25-187	621.25	R16-s	A112	Reactor Water Cleanup Panel	47W481-5	Equipment	With 3-25-36A/B
0-25-190	578.0	W01-a	B118	Floor Drain Sample Tank Panel			Valved
0-25-193	566.0	SGT Bldg	B55	Standby Gas Treatment A Panel			Valved
0-25-194	566.0	SGT Bldg	B55	Standby Gas Treatment B Panel			Valved
0-25-207	578.0	W03-b	B67	FD Sample CV Panel			Manifolded; plugged

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
0-25-211	599.5	Stack	B112	Offgas Oil & Filter Cub Exhaust Panel			Manifolded; open and plastic capped
0-25-214	565.0	W05-b	C118	Waste & FD Filter Panel			Electrical; no drain
0-25-216	565.0	T11-m	E110	Condensate Transfer Pump Panel			Manifolded; open
1-25-225A	519.0	R01-n	B129	Core Spray Drain Pump Pressure Panel	47W476-1	Floor	With 1-25-58
1-25-225B	519.0	R07-n	B129	Core Spray Drain Pump Pressure Panel	47W476-1	Equipment	With 1-25-21, 1-25-60, 1-25-81
2-25-225A	519.0	R08-n	B129	Core Spray Drain Pump Pressure Panel	47W476-2	Equipment	With 2-25-1, 2-25-21
2-25-225B	519.0	R13-p	B129	Core Spray Drain Pump Pressure Panel	47W476-2	Equipment	
0-25-227	593.0	R02-r	D126	Standby Gas Treatment Air Flow Panel			Electrical and pneumatic; no drain
0-25-237	565.0	RWE Bldg	Key 009	Chemical Solidification Panel			Electrical; no drain
0-25-238	565.0	RWE Bldg	A154	Distillate and Solidification Panel	47W561-1	Floor	With 0-25-239 (sample sink) into open funnel drain; drain line sloped upgrade
0-25-240	565.0	RWE Bldg	Key 009	Evaporator Control Panel			Capillaries and electrical; no drain
1-25-256	519.0	R01-n	C133	Suppression Chamber Pump Press Panel			Valved
2-25-256	519.0	R08-n	C133	Suppression Chamber Pump Press Panel			Valved
3-25-256	519.0	R15-n	C133	Suppression Chamber Pump Press Panel			Valved
0-25-258	565.0	W06-c	B148	Auxiliary Radwaste Panel			Electrical; no drain
0-25-260	565.0	W06-b	A148	Sump Pump Time Run Meters			Electrical; no drain
1-25-262	557.0	T05-d	A149	RFW Inj Water Duplex Strainer Panel			Not used
2-25-262	557.0	T07-d	A149	RFW Inj Water Duplex Strainer Panel			Not used
3-25-262	557.0	T13-d	A149	RFW Inj Water Duplex Strainer Panel			No drain
1-25-263	557.0	T05-g	B149	Cond Demin Precoat Tank Surge Panel			Not found; not where shown
2-25-263	557.0	T07-g	B149	Cond Demin Precoat Tank Surge Panel			Not found; not where shown
3-25-263	557.0	T13-g	B149	Cond Demin Precoat Tank Surge Panel			Not found; not where shown
0-25-268	566.0	SGT Bldg	B55	Standby Gas Treatment C Panel			Valved
0-25-272A	568.0	Stack	A153	Standby Gas Treatment Flow Panel			No drain
0-25-272B	568.0	Stack	A153	Standby Gas Treatment Flow Panel			Electrical; no drain
0-25-273A	568.0	Stack	A153	Standby Gas Treatment Flow Panel			No drain
0-25-273B	568.0	Stack	A153	Standby Gas Treatment Flow Panel			Electrical; no drain

PANEL	ELEV	AREA	DWG 47W600 DETAIL	PANEL DESCRIPTION	DRAIN DRAWING	DRAIN SUMP	REMARKS
1-25-278	604.0	T02-c	A159	Hotwell Pressure Panel			Drains with 1-25-115 to condenser at El. 586
2-25-278	604.0	T10-c	A159	Hotwell Pressure Panel			Drains with 2-25-115 to condenser at El. 586
3-25-278	604.0	T16-c	A159	Hotwell Pressure Panel			Drains with 3-25-115 to condenser at El. 586
1-25-301	541.5	R07-n	(171)	CRD Pump Suction Filter Panel			Not found; not where shown
2-25-301	541.5	R08-n	(171)	CRD Pump Suction Filter Panel			Not found; not where shown
3-25-301	541.5	R15-n	(171)	CRD Pump Suction Filter Panel			Not found; not where shown
0-25-304	565.0	W03-c	A142	Effluent Resin Trap Panel			Not found; not where shown
0-25-309	565.0	W02-d	B142	Effluent Filter Panel			Not found; not where shown
1-25-314	593.0	R05-t	B193	RWCU Pump Seal Panel			Valved; leaking on floor
2-25-314	593.0	R12-t	B193	RWCU Pump Seal Panel			Valved
3-25-314	593.0	R19-t	B193	RWCU Pump Seal Panel			Valved; bottom of panel at El. 600
1-25-335	557.0	T06-c	A193	Offgas Condenser Panel	47W479-1	Equipment	With 1-25-122
2-25-335	557.0	T06-c	A193	Offgas Condenser Panel			
3-25-335	557.0	T12-c	A193	Offgas Condenser Panel			Manifolded; open
0-25-359	577.0	Yard	A208	Condensate Storage Tank			Valved drain inside cabinet
0-25-360	577.0	Yard	A208	Condensate Storage Tank			Valved drain inside cabinet

TABLE 19
BFN HOT SAMPLE STATION TABULATION

PANEL	ELEV	AREA	DWG 47W448 SEC/DETAIL	DESCRIPTION	UNIT	DRAIN DWG	DRAIN SUMP	REMARKS
1-25-103	557.0	T04-d	C3-C3	Condenser Sampling Panel	1	47W479-1	Equipment	With 1-25-103
2-25-103	557.0	T10-d	C3-C3	Condenser Sampling Panel	2	47W479-1	Equipment	With 2-25-103
3-25-103	557.0	T16-d	C3-C3	Condenser Sampling Panel	3			With 3-25-103; not traceable
1-25-148	557.0	T06-g	A5-A5	Condensate Demineralizer Samp Panel	1	47W479-2	Floor	
2-25-148	557.0	T06-g	A5-A5	Condensate Demineralizer Samp Panel	2	47W479-2	Floor	
3-25-148	557.0	T13-g	A5-A5	Condensate Demineralizer Samp Panel	3	47W479-4	Floor	
	565.0	W05-b	A8-A8	Radwaste Sample Station	C			Drains into chem waste tank at El 546.0
1-25-009	621.25	R06-s	A9-A9	Reactor Water Cleanup Sample Station	1	47W481-5	Equipment	
2-25-009	621.25	R09-s	A9-A9	Reactor Water Cleanup Sample Station	2	47W481-5	Equipment	
3-25-009	621.25	R16-s	A9-A9	Reactor Water Cleanup Sample Station	3	47W481-5	Equipment	
	621.25	R06-s	A9-A9	Hooded Sample Station	1			With 1-25-9
	621.25	R09-s	A9-A9	Hooded Sample Station	2			With 2-25-9
	621.25	R16-s	A9-A9	Hooded Sample Station	3			With 3-25-9
	621.25	R06-s	E9-E9	Reactor Recirc Sample Station	1			To hooded sample station
	621.25	R09-s	E9-E9	Reactor Recirc Sample Station	2			To hooded sample station
	621.25	R16-s	E9-E9	Reactor Recirc Sample Station	3			To hooded sample station
1-25-149	586.0	T04-k	A10-A10	Main Steam and Feedwater Sample Sta	1	47W477-2	Floor	With 1-25-112, 1-25-113A/D
2-25-149	586.0	T08-k	A10-A10	Main Steam and Feedwater Sample Sta	2	47W477-2	Floor	With 2-25-112, 2-25-113A/D
3-25-149	586.0	T14-k	A10-A10	Main Steam and Feedwater Sample Sta	3	47W477-3	Floor	With 3-25-112, 3-25-113A/D
	586.0	T05-f	B10-B10	Condensate Sample Station	1	47W477-1	Floor	With 1-25-108
	586.0	T07-f	B10-B10	Condensate Sample Station	2	47W477-1	Floor	With 2-25-108
	586.0	T13-f	B10-B10	Condensate Sample Station	3	47W477-3	Floor	With 3-25-108
	519.0	R01-t	A11-A11	RHR Sampling Station	1	47W476-1	Floor	
	519.0	R07-t	B11-B11	RHR Sampling Station	1	47W476-1	Floor	
	519.0	R08-t	C11-C11	RHR Sampling Station	2	47W476-2	Floor	
	519.0	R14-t	D11-D11	RHR Sampling Station	2	47W476-2	Floor	
	519.0	R15-t	C11-C11	RHR Sampling Station	3	47W476-3	Floor	
	519.0	R21-t	D11-D11	RHR Sampling Station	3	47W476-3	Floor	

TABLE 19
BFN HOT SAMPLE STATION TABULATION

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PANEL	ELEV	AREA	DWG 47W448 SEC/DETAIL	DESCRIPTION	UNIT	DRAIN DWG	DRAIN SUMP	REMARKS
	565.0	R02-u	A12-A12	RHR Service Water Sampling Station	1	47W481-9	Floor	Piped to funnel drain
	565.0	R04-u	B12-B12	RHR Service Water Sampling Station	1	47W481-9	Floor	Piped to funnel drain
	565.0	R10-u	C12-C12	RHR Service Water Sampling Station	2	47W481-9	Floor	Piped to funnel drain
	565.0	R12-u	D12-D12	RHR Service Water Sampling Station	2	47W481-9	Floor	Piped to funnel drain
	565.0	R17-u	E12-E12	RHR Service Water Sampling Station	3	47W481-9	Floor	Piped to funnel drain
	565.0	R20-u	F12-F12	RHR Service Water Sampling Station	3	47W481-9	Floor	Piped to funnel drain
	593.0	R06-q	B13-B13	Non-Regenerative HTX Sampling Station	1	47W481-7	Floor	Terminates on floor within 12 inches of floor drain
	593.0	R09-q	B13-B13	Non-Regenerative HTX Sampling Station	2	47W481-7	Floor	Terminates on floor within 12 inches of floor drain
	593.0	R16-q	B13-B13	Non-Regenerative HTX Sampling Station	3	47W481-7	Equipment	
	519.0	R06-g	A14-A14	RBED Sump Heat Exchanger Sample Sta	1	47W476-1	Floor	
	519.0	R13-g	A14-A14	RBED Sump Heat Exchanger Sample Sta	2	47W476-2	Floor	
	519.0	R20-g	A14-A14	RBED Sump Heat Exchanger Sample Sta	3	47W476-3	Floor	
0-25-128	565.0	W08-b	C14-C14	Chem Lab Monitoring Station	C			Drains into chem waste tank at El 546.0
	586.0	T05-k	A17	Sample Sta, Heaters No. 1 and 2	1			Drains thru floor sleeve; not traceable
	586.0	T07-k	A17	Sample Sta, Heaters No. 1 and 2	2			Drains thru floor sleeve; not traceable
	586.0	T18-k	A17	Sample Sta, Heaters No. 1 and 2	3			Drains thru floor sleeve; not traceable
	586.0	T04-m	A17-A17	Main Steam Startup Sample Station	1			Not found; not where shown
	586.0	T05-e	B17	Sample Sta, Heaters No. 3, 4 and 5	1	47W477-1	Floor	With 1-25-109
	586.0	T07-e	B17	Sample Sta, Heaters No. 3, 4 and 5	2	47W477-1	Floor	With 2-25-109
	586.0	T13-g	B17	Sample Sta, Heaters No. 3, 4 and 5	3	47W477-3	Floor	With 3-25-107
1-25-094	538.5	OGT Bldg	A18	Off Gas Sample Panel	1			Valved
2-25-094	538.5	OGT Bldg	A18	Off Gas Sample Panel	2			Valved
3-25-094	538.5	OGT Bldg	A18	Off Gas Sample Panel	3			Valved
1-25-254A	604.0	T06-c	B18	Off Gas Hydrogen Analyzer	1			No drain
1-25-254B	604.0	T06-c	B18	Off Gas Hydrogen Analyzer	1			No drain
2-25-254A	604.0	T06-c	B18	Off Gas Hydrogen Analyzer	2			No drain

TABLE 19
BFN HOT SAMPLE STATION TABULATION

PANEL	ELEV	AREA	DWG 47W448 SEC/DETAIL	DESCRIPTION	UNIT	DRAIN DWG	DRAIN SUMP	REMARKS
2-25-254B	604.0	T06-c	B18	Off Gas Hydrogen Analyzer	2			No drain
3-25-254A	604.0	T13-c	B18	Off Gas Hydrogen Analyzer	3			No drain
3-25-254B	604.0	T13-c	B18	Off Gas Hydrogen Analyzer	3			No drain
0-25-239	565.0	RWE Bldg	A19-A19	Radwaste Evaporator Sample Station	C	47W561-1	Floor	
	565.0	T11-m	A20-A20	Condensate Transfer Pumps Sample Sta	C			Not found; not where shown

TABLE 20
BLN HOT INSTRUMENT PANEL TABULATION
AUXILIARY BUILDING

PANEL	ELEV	AREA	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN NO./DET	DRAIN TERMINATION	REMARKS
1IX-ILPA 005	629	A 6-T	5AW0925-NV-05-R2	NV	3AW0462-00-25-R9	DR 0304-D2	Tritiated Waste Holdup Tank	
2IX-ILPA 005	629	A 8-T	5AW0925-NV-05-R2	NV	3AW0462-00-27-R7	DR 0309-D2	Tritiated Waste Holdup Tank	Panel not installed
1IX-ILPA 006	629	A 6-T	5AW0925-NV-05-R2	NV	3AW0462-00-25-R9	DR 0301-D2	Tritiated Waste Holdup Tank	
2IX-ILPA 006	629	A 8-T	5AW0925-NV-05-R2	NV	3AW0462-00-27-R7	DR 0308-D2	Tritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 007	629	A 6-T	5AW0925-NV-05-R2	NV	3AW0462-00-25-R9	DR 0300-D2	Tritiated Waste Holdup Tank	
2IX-ILPA 007	629	A 8-T	5AW0925-NV-05-R2	NV	3AW0462-00-27-R7	DR 0310-D2	Tritiated Waste Holdup Tank	Panel not installed
0IX-ILPA 008	629	A 8-U	5AW0925-NG-08-R2	NG	3AW0462-00-27-R7	DR 0311-D2	Tritiated Waste Holdup Tank	Drain not connected
0IX-ILPA 009	629	A 8-U	5AW0925-NG-08-R2	NG	3AW0462-00-27-R7	DR 0311-D2	Tritiated Waste Holdup Tank	Drain not connected
2IX-ILPA 010	629	A 6-Q	5AW0925-NB-07-R5	NB	3AW0462-00-24-R4	DR 0297-D2	Tritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 010	629	A 6-R	5AW0925-NB-07-R5	NB	3AW0462-00-24-R4	DR 0292-D2	Tritiated Waste Holdup Tank	
1IX-ILPA 011A	629	A 6-Q	5AW0925-NB-11-R1	NB	3AW0462-00-24-R4	Floor drain A1	Tritiated Waste Holdup Tank	Drains thru wall sleeve
2IX-ILPA 011A	629	A 6-Q	5AW0925-NB-11-R1	NB	3AW0462-00-24-R4	Floor drain A1	Tritiated Waste Holdup Tank	Drains thru wall sleeve
1IX-ILPA 013	583	A 5-Q	5AW1925-NB-13-R3	NS	3AW0462-00-01-R9	Floor drain A1		
2IX-ILPA 013	583	A10-Q	5AW1925-NB-13-R3	NS	3AW0462-00-01-R9	Floor drain A1		
1IX-ILPA 014	590	A 7-Q	5AW1925-NB-13-R3	NB	3AW0462-00-05-R5	DR 1126-D2	Tritiated Sump Tank	
2IX-ILPA 014	590	A 8-Q	5AW1925-NB-13-R3	NB	3AW0462-00-07-R5	DR 1153-D2	Tritiated Sump Tank	Drain not connected
0IX-ILPA 015	568	A 9-S	5AW0925-WL-15-R2	WL	3AW0462-00-01-R9			Area flooded; panel not accessible
0IX-ILPA 016	568	A 8-S	5AW0925-WL-15-R2	WL	3AW0462-00-01-R9			Area flooded; panel not accessible
1IX-ILPA 028B	590	A 2-R	5AW0925-ND-28-R5	ND	3AW0462-00-03-R11	DR 1067-D2	Tritiated Sump Tank	Drain not where shown
2IX-ILPA 028B	590	A13-R	5AW0925-ND-28-R5	ND	3AW0462-00-09-R8	DR 1256-D2	Tritiated Sump Tank	Drain not connected
0IX-ILPA 029	590	A 8-S	5AW0925-WL-29-R1	WL	3AW0462-00-07-R5	DR 1158-D2	Tritiated Sump Tank	
0IX-ILPA 030	590	A 8-S	5AW0925-WL-29-R1	WL	3AW0462-00-07-R5	DR 1158-D2	Tritiated Sump Tank	
0IX-ILPA 031	590	A 8-R	5AW1925-WL-32-R3	WL	3AW0462-00-07-R5	DR 1158-D2	Tritiated Sump Tank	Drain not connected
1IX-ILPA 032	590	A 5-T	5AW1925-WL-32-R3	WL	3AW0462-00-06-R7	DR 1136-D2	Tritiated Sump Tank	
2IX-ILPA 032	590	A10-T	5AW2925-WL-35-R1	WL	3AW0462-00-08-R7	DR 1199-D2	Tritiated Sump Tank	
1IX-ILPA 033	590	A 5-R	5AW1925-NV-33-R6	NV	3AW0462-00-05-R5	DR 1123-D2	Tritiated Sump Tank	
2IX-ILPA 033	590	A10-R	5AW2925-NV-33-R5	NV	3AW0462-00-07-R5	DR 1171-D2	Tritiated Sump Tank	Drain not connected
1IX-ILPA 034A	590	A 5-S	5AW1925-NV-33-R6	NV	3AW0462-00-05-R5	DR 1123-D2	Tritiated Sump Tank	

PANEL	ELEV	AREA	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN NO./DET	DRAIN TERMINATION	REMARKS
2IX-ILPA 034A	590	A10-S	5AW2925-HV-33-R5	HV	3AW0462-00-07-R5	DR 1171-D2	Tritiated Sump Tank	Drain not connected
1IX-ILPA 035	590	A 5-U	5AW1925-WL-35-R0	WL	3AW0462-00-06-R7	Floor drain B1	Nontritiated Sump Tank	
2IX-ILPA 035	590	A10-U	5AW2925-WL-35-R1	WL	3AW0462-00-08-R7			Solenoid valves - no drain required
0IX-ILPA 036	590	A10-S	5AW1925-WL-35-R0	WL	3AW0462-00-07-R5	DR 1174-D2	Tritiated Sump Tank	Drain not connected
0IX-ILPA 037	590	A 7-U	5AW0925-WL-37-R5	WL	3AW0462-00-06-R7	DR 1151-D2	Tritiated Sump Tank	
0IX-ILPA 038	590	A 7-U	5AW1925-WL-41-R1	WL	3AW0462-00-06-R7	DR 1151-D2	Tritiated Sump Tank	
0IX-ILPA 039	590	A 7-V	5AW0925-WL-40-R2	WL	3AW0462-00-06-R7	Leak detector L2	Tritiated Sump Tank	
0IX-ILPA 040	590	A 9-V	5AW0925-WL-40-R2	WL	3AW0462-00-08-R7			Transmitter - no drain required
1IX-ILPA 041	590	A 7-T	5AW1925-WL-41-R1	WL	3AW0462-00-06-R7	Floor drain A1	Nontritiated Sump Tank	
2IX-ILPA 041	590	A 8-T	5AW2925-WL-35-R1	WL	3AW0462-00-08-R7	Floor drain B1	Nontritiated Sump Tank	
0IX-ILPA 042	568	A 9-R	5AW0925-WL-69-R2	WL	3AW0462-00-01-R9			Area flooded; panel not accessible
0IX-ILPA 043	590	A 8-R	5AW0925-WL-43-R0	WL	3AW0462-00-07-R5	DR 1154-D2	Tritiated Sump Tank	Drain not connected
1IX-ILPA 048A	640	A 1-U	5AW1925-HD-49-R8	HS	3AW0462-00-31-R8			No drain required
2IX-ILPA 048A	640	A14-U	5AW1925-HD-49-R8	HS	3AW0462-00-32-R6			No drain required
1IX-ILPA 049B	629	A 1-T	5AW1925-HD-49-R8	HS	3AW0462-00-23-R6	DR 0339-D2	Tritiated Waste Holdup Tank	Via leak detector L2
2IX-ILPA 049B	629	A14-T	5AW1925-HD-49-R8	HS	3AW0462-00-29-R6	DR 0350-D2	Tritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 050	629	A 5-T	5AW1925-HV-50-R4	HV	3AW0462-00-25-R9	DR 0289-D2	Nontritiated Waste Holdup Tank	
2IX-ILPA 050	629	A10-T	5AW1925-HV-50-R4	HV	3AW0462-00-27-R7	DR 0319-D2	Nontritiated Waste Holdup Tank	
1IX-ILPA 051	629	A 5-V	5AW0925-HV-73-R1	HV	3AW0462-00-25-R9			No drain required
2IX-ILPA 051	629	A10-V	5AW0925-HV-73-R1	HV	3AW0462-00-27-R7			No drain required
1IX-ILPA 052A	629	A 3-T	5AW0925-HV-52-R4	HV	3AW0462-00-23-R6	DR 0351-D2	Tritiated Waste Holdup Tank	
2IX-ILPA 052A	629	A12-T	5AW0925-HV-52-R4	HV	3AW0462-00-29-R6	DR 0322-D2	Nontritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 054B	629	A 2-T	5AW0925-HV-54-R4	HV	3AW0462-00-23-R6			Drain not connected
2IX-ILPA 054B	629	A13-T	5AW0925-HV-54-R4	HV	3AW0462-00-29-R6			Drain not connected
1IX-ILPA 055	629	A 6-T	5AW0925-HV-05-R2	HV	3AW0462-00-25-R9	DR 0304-D2	Tritiated Waste Holdup Tank	
2IX-ILPA 055	629	A 8-T	5AW0925-HV-05-R2	HV	3AW0462-00-27-R7	DR 0308-D2	Tritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 056A	629	A 5-V	5AW0925-HV-54-R4	HV	3AW0462-00-25-R9	DR 0295-D2	Nontritiated Waste Holdup Tank	
2IX-ILPA 056A	629	A10-V	5AW0925-HV-54-R4	HV	3AW0462-00-27-R7	DR 0316-D2	Nontritiated Waste Holdup Tank	Drain not connected
1IX-ILPA 057A	610	A 2-R	5AW0925-HD-57-R3	HD	3AW0462-00-03-R11	DR 1007-D2	Tritiated Sump Tank	Drains thru floor sleeve to Elev. 590
2IX-ILPA 057B	610	A13-R	5AW0925-HD-57-R3	HD	3AW0462-00-09-R8	DR 1256-D2	Tritiated Sump Tank	Drains thru floor sleeve to Elev. 590;

TABLE 20
GEN HOT INSTRUMENT PANEL TABULATION
AUXILIARY BUILDING

REPORT NUMBER: 22900
REVISION NUMBER: 5

PANEL	ELEV	AREA	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN NO./DET	DRAIN TERMINATION	REMARKS
01X-ILPA 069	590	A 7-R	5AW0925-WL-69-R2	WL	3AW0462-00-05-R5	Floor drain A1	Tritiated Sump Tank	
11X-ILPA 072A	610	A 5-R	5AW1925-VL-72-R4	NV	3AW0462-00-05-R5	DR 1123-02	Tritiated Sump Tank	Drains thru floor sleeve to Elev. 590
21X-ILPA 072B	610	A10-R	5AW2925-VL-72-R3	HV	3AW0462-00-15-R5	DR 0058-02	Nontritiated Waste Holdup Tank	Drain not connected
11X-ILPA 073	649	A 7-U	5AW0925-HV-73-R1	HV	3AW0462-00-31-R8			All pneumatic - no drain required
21X-ILPA 073	649	A 8-U	5AW0925-HV-73-R1	HV	3AW0462-00-32-R6			All pneumatic - no drain required
01X-ILPA 075	610	A10-T	5AW0925-WL-75-R0	WL	3AW0462-00-16-R7			Drain not connected
11X-ILPA 076	667	A 6-W	5AW1925-HM-76-R3	HM	3AW0462-00-30-R4			Capillaries - no drain required
21X-ILPA 076	667	A 9-W	5AW1925-HM-76-R3	HM	3AW0462-00-30-R4			Capillaries - no drain required
01X-ILPA 079	590	A 7-S	5AW0925-WL-75-R0	WL	3AW0462-00-05-R5			Solenoid valves - no drain required
11X-ILPA 097B	610	A 2-T	5AW1925-VL-97-R1	HD	3AW0462-00-12-R3			Drain not connected
21X-ILPA 097B	610	A13-T	5AW2925-VL-97-R1	HD	3AW0462-00-18-R3			Drain not connected
01X-ILPA 102	622	A 9-Y	5AW0926-HM-02-R3	HM	3AW0462-00-20-R10	DR 0401-02	Nontritiated Waste Holdup Tank	
11X-ILPA 104	622	A 7-X	5AW1926-HM-04-R1	HM	3AW0462-00-20-R10	DR 0435-02	Tritiated Waste Holdup Tank	
21X-ILPA 104	622	A 8-X	5AW2926-HM-04-R1	HM	3AW0462-00-20-R10	DR 0433-02	Nontritiated Waste Holdup Tank	Drain not connected
01X-ILPA 105	568	A 8-R	5AW0925-WL-69-R2	WL	3AW0462-00-01-R9			Area flooded; panel not accessible
01X-ILPA 106	649	A 8-Q	5AW0926-HB-49-R1	HB	3AW0462-00-32-R6			All electric - no drain required
01X-ILPA 109	590	A 7-V	5AW1926-WL-10-R0	WL	3AW0462-00-06-R7			Solenoid valves - no drain required
11X-ILPA 110	590	A 5-T	5AW1926-WL-10-R0	WL	3AW0462-00-06-R7			All electric - no drain required
21X-ILPA 110	590	A10-U	5AW2925-WL-35-R1	WL	3AW0462-00-08-R7			All electric - no drain required
11X-ILPA 111	590	A 1-R	5AW1926-HD-11-R0	HD	3AW0462-00-03-R11			Panel not accessible
21X-ILPA 111	590	A14-R	(		3AW0462-00-09-R8			Unable to locate; panel not where shown
11X-ILPA 112A	622	A 8-Y	5AW1926-RE-12-R4	HM	3AW0462-00-20-R10	DR 0409-02	Nontritiated Waste Holdup Tank	
21X-ILPA 112A	622	A 9-Z	5AW1926-RE-12-R4	HM	3AW0462-00-20-R10	DR 0402-02	Nontritiated Waste Holdup Tank	Drain not connected
01X-ILPA 116	610	A 7-V	5AW0926-HG-16-R0	HG	3AW0462-00-14-R7			Drain not connected
11X-ILPA 121A	629	A 3-T	5AW1925-RE-93-R4	NV	3AW0462-00-23-R6	DR 0221-02	Tritiated Waste Holdup Tank	
11X-ILPA 121A	629	A12-T	(		3AW0462-00-29-R6	DR 0321-02	Tritiated Waste Holdup Tank	Drain not connected
01X-ILPA 136	610	A 7-T	5AW0925-WL-37-R5	WL	3AW0462-00-06-R7	DR 1150-02	Tritiated Sump Tank	Drains thru floor sleeve to Elev. 590;
21X-ILPA 138	622	A 6-X	5AW2926-HM-38-R1	HM	3AW0462-00-20-R10	DR 0495-02	Tritiated Waste Holdup Tank	Drain not connected
11X-ILPA 138	622	A 6-Y	5AW1926-HM-38-R1	HM	3AW0462-00-20-R10	DR 0495-02	Tritiated Waste Holdup Tank	
11X-ILPA 144B	696	A 1-U	5AW1925-RD-49-R8	NS	3AW0462-00-31-R6			Capillaries and electric - no drain required

PANEL	ELEV	AREA	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN NO./OUT	DRAIN TERMINATION	REMARKS
21X-ILPA 144B	846	A14-0	5AW1925-KD-49-R6	HS	3AW0462-00-32-R0			Capillaries and electric - no drain required
01X-ILPA 145	810	A 5-S	5AW0926-WL-45-R2	WL	3AW0462-00-13-R5	Floor drain AI	Tritiated Waste Holdup Tank	
01X-ILPA 149	849	A 8-Q	5AW0926-HD-50-R2	HD	3AW0462-00-32-R0	DR 0084-02	Tritiated Waste Holdup Tank	
01X-ILPA 150	849	A 8-Q	5AW0926-HD-50-R2	HD	3AW0462-00-32-R0	DR 0084-02	Tritiated Waste Holdup Tank	
01X-ILPA 151	849	A 8-Q	5AW0926-HD-49-R1	HD	3AW0462-00-32-R0	DR 0085-02	Tritiated Waste Holdup Tank	
11X-ILPA 166A	849	A 7-0	5AW0926-NV-66-R3	NV	3AW0462-00-31-R8			Panel enclosed - no drain required
21X-ILPA 166A	849	A 8-0	5AW0926-NV-66-R3	NV	3AW0462-00-32-R0			All electric - no drain required
11X-ILPA 177A	590	A 4-Q	5AW1925-NV-33-R6	NV	3AW0462-00-03-R11	DR 1099-02	Nontritiated Sump Tank	
21X-ILPA 177A	590	A11-Q	5AW2925-NV-33-R5	NV	3AW0462-00-09-R8			Solenoid valves - no drain required
11X-ILPA 178A	590	A 3-Q	5AW1925-NV-33-R6	NV	3AW0462-00-03-R11	DR 1100-02	Nontritiated Sump Tank	
21X-ILPA 178A	590	A12-Q	5AW2925-NV-33-R5	NV	3AW0462-00-09-R8			Solenoid valves - no drain required
11X-ILPA 179B	590	A 3-Q	5AW0925-ND-28-R5	ND	3AW0462-00-03-R11	DR 1078-02	Nontritiated Sump Tank	
21X-ILPA 179B	590	A12-Q	5AW0925-ND-28-R5	ND	3AW0462-00-09-R8			Solenoid valves - no drain required
11X-ILPA 184A	849	A 4-T	5AW0925-NV-52-R4	NV	3AW0462-00-31-R8			All electric - no drain required
21X-ILPA 184A	849	A11-T	5AW0925-NV-52-R4	NV	3AW0462-00-32-R0			All electric - no drain required
11X-ILPA 185B	849	A 1-T	5AW0925-NV-52-R4	NV	3AW0462-00-31-R8			All electric - no drain required
21X-ILPA 185B	849	A14-T	5AW0925-NV-52-R4	NV	3AW0462-00-32-R0			All electric - no drain required
11X-ILPA 186	849	A 5-0	5AW0925-NV-52-R4	NV	3AW0462-00-31-R8			All electric - no drain required
21X-ILPA 186	849	A10-0	5AW0925-NV-52-R4	NV	3AW0462-00-32-R0			All electric - no drain required
01X-ILPA 187	590	A 9-0	5AW0925-WL-43-R0	WL	3AW0462-00-08-R7	DR 1186-02	Tritiated Sump Tank	
11X-ILPA 190	590	A 2-S	5AW1926-HS-90-R0	HS	3AW0462-00-03-R11			Unable to locate; panel not where shown
21X-ILPA 190	590	A13-S	?		3AW0462-00-09-R6			Unable to locate; panel not where shown
11X-ILPA 191	590	A 5-S	5AW1926-HS-90-R0	HS	3AW0462-00-05-R5			Unable to locate; panel not where shown
21X-ILPA 191	590	A10-S	?		3AW0462-00-07-R5			Unable to locate; panel not where shown
11X-ILPA 198	849	A 5-0	5AW0925-NV-52-R4	NV	3AW0462-00-31-R8			All electric - no drain required
21X-ILPA 198	849	A10-0	5AW0925-NV-52-R4	NV	3AW0462-00-32-R0			All electric - no drain required
01X-ILPA 203	847	A 7-Y	5AW0927-WL-03-R2	WL	3AW0462-00-37-R3			Unable to locate; panel not where shown
01X-ILPA 211B	822	A 9-Y	5AW1926-RE-12-R4	RE	3AW0462-00-20-R10	DR 0406-02	Nontritiated Waste Holdup Tank	
11X-ILPA 212	829	A 7-T	5AW1927-HD-12-R1	HD	3AW0426-00-25-R9			Cabinet - no drain required
21X-ILPA 212	829	A 9-T	5AW2927-HD-12-R0	HD	3AW0462-00-27-R7			Unable to locate; panel not where shown
01X-ILPA 219	822	A 9-Y	5AW0927-WL-03-R2	WL	3AW0462-00-20-R10			Unable to locate; panel not where shown
01X-ILPA 220	822	A 6-Y	5AW0927-WL-03-R2	WL	3AW0462-00-20-R10			Unable to locate; panel not where shown

TABLE 21
BLN HOT INSTRUMENT PANEL TABULATION
REACTOR BUILDING, UNIT 1

PANEL	FLOOR ELEV	AZIMUTH	SITE	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN AZIMUTH	DRAIN DETAIL	REMARKS
1IX-1LPR 001D	670	312° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5			With 003F; not completed
1IX-1LPR 002A	670	317° *	IN RM	"		3RW0403-00-06-R5	318° 20'	F6	With 030
1IX-1LPR 003F	670	311° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5			With 001D; not completed
1IX-1LPR 004E	670	326° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5	314° 17'	D1	With 005B and 006G
1IX-1LPR 005B	670	330° *	IN RM	"		3RW0403-00-06-R5	314° 17'	D1	With 004E and 006G
1IX-1LPR 006G	670	323° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5	314° 17'	D1	With 004E and 005B
1IX-1LPR 007	670	317° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5			No drain connected
1IX-1LPR 009D	670	60°	PW-UF	5RW1925-NS-09-R1	NS	3RW0403-00-06-R5			Unable to locate; panel not where shown
1IX-1LPR 010	670	339° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5			Drain lines not completed
1IX-1LPR 019A	622	98° 15'	PW-UF	5RW1925-NL-03-R4	NL	3RW0403-00-03-R8			No drain required
1IX-1LPR 020B	622	98° 15'	PW-UF	5RW1925-NL-03-R4	NL	3RW0403-00-03-R8			No drain required
1IX-1LPR 021A	622	249°	PW-UF	5RW1925-NL-03-R4	NL	3RW0403-00-03-R8			No drain connected
1IX-1LPR 022B	622	242°	PW-UF	5RW1925-NL-03-R4	NL	3RW0403-00-03-R8			No drain connected
1IX-1LPR 023D	622	293° 30'	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-02-R7	299°	D1	With 025F & 027A
1IX-1LPR 024E	622	268°	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-03-R8	272°	D1	With 026G
1IX-1LPR 025F	622	297°	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-02-R7	299°	D1	With 023D & 027A
1IX-1LPR 026G	622	272°	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-02-R7	272°	D1	With 024E
1IX-1LPR 027A	622	289° 30'	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-02-R7	299°	D1	With 023D & 025F
1IX-1LPR 028B	622	279° 45'	PW-UF	5RW1925-NC-06-R5	NC	3RW0403-00-02-R7	282°	D1	
1IX-1LPR 029A	670	67° 30'	PW-UF	5RW1925-NS-09-R1	NS	3RW0403-00-06-R5			Unable to locate; panel not where shown
1IX-1LPR 030	670	318° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5	318° 20'	F6	With 002A
1IX-1LPR 031	670	315° *	IN RM	5RW1925-NC-05-R3	NC	3RW0403-00-06-R5			No drain line from manifold
1IX-1LPR 037	622	291°	IN WL	5RW1925-WL-53-R3	WL	3RW0403-00-02-R7			No drain connected
1IX-1LPR 038B	700	5°	SW-IF	5RW1925-NS-38-R1	NS	3RW0403-00-07-R5			Drain lines 6 inches long and capped
1IX-1LPR 039F	670	115°	PW-UF	5RW1925-NS-39-R1	NS	3RW0403-00-06-R5			Drain not connected
1IX-1LPR 040G	670	265°	PW-UF	5RW1925-NS-39-R1	NS	3RW0403-00-06-R5			Unable to locate; panel not where shown
1IX-1LPR 046	622	339° 50'	PW-IF	5RW0925-HU-46-R3	HU	3RW0403-00-02-R7			Drain not connected
1IX-1LPR 047	622	72° 40'	PW-IF	5RW0925-HU-46-R3	HU	3RW0403-00-02-R7			Drain lines 6 inches long and capped
1IX-1LPR 048	622	65°	INTER	5RW1925-WL-53-R3	WL	3RW0403-00-02-R7			Panel not installed
1IX-1LPR 052	622	265°	IN WL	5RW1925-WL-52-R1	WL	3RW0403-00-02-R7			No drain required
1IX-1LPR 053	640	35°	SW-IF	5RW1925-WL-53-R3	WL	3RW0403-00-05-R10			All electric-no drain required
1IX-1LPR 054	640	45°	SW-IF	5RW1925-WL-52-R1	WL	3RW0403-00-05-R10			All electric-no drain required
1IX-1LPR 055	622	245°	IN WL	5RW1925-NL-55-R3	NL	3RW0403-00-03-R8			Unable to locate; panel not where shown
1IX-1LPR 056	622	72° 40'	PW-IF	5RW1925-NL-55-R3	NL	3RW0403-00-02-R7			Drain lines 6 inches long and capped
1IX-1LPR 057	622	65°	INTER	5RW1925-WL-53-R3	WL	3RW0403-00-02-R7			Panel not installed
1IX-1LPR 058A	622	68°	PW-UF	5RW1925-NC-26-R3	NC	3RW0403-00-02-R7			Drain lines not completed
1IX-1LPR 059B	622	110°	PW-UF	5RW1925-NC-26-R3	NC	3RW0403-00-03-R8	115°	D1	
1IX-1LPR 060A	622	65°	PW-UF	5RW1925-NC-26-R3	NC	3RW0403-00-02-R7			Drain lines parallel with 058A; not completed
1IX-1LPR 061A	622	65°	PW-UF	5RW1925-NC-26-R3	NC	3RW0403-00-02-R7			No drain required
1IX-1LPR 062B	622	113°	PW-UF	5RW1925-NC-26-R3	NC	3RW0403-00-03-R8	115°	D1	

TABLE 21
GEN HOT INSTRUMENT PANEL TABULATION
REACTOR BUILDING, UNIT 1

REPORT NUMBER: 22900
REVISION NUMBER: 5

PANEL	FLOOR ELEV	AZIMUTH	SITE	PANEL DRAWING	SYS	DRAIN DRAWING	DRAIN AZIMUTH	DRAIN DETAIL	REMARKS
1IX-ILPR 063B	622	190°	PW-OF	5RW1925-NC-26-R3	NC	3RW0463-00-03-R8	187°	D1	
1IX-ILPR 064	622	65°	INTER	5RW1925-WL-53-R3	WL	3RW0463-00-02-R7			Panel not installed
1IX-ILPR 084B	646	306°	SW-IF	5RW1925-NC-24-R3	NC	3RW0463-00-05-R10			Drains with 026G of Elev. 622
1IX-ILPR 085A	646	348° 30'	SW-IF	5RW1925-NC-24-R3	NC	3RW0463-00-05-R10	322°		With 086F; not completed
1IX-ILPR 086F	646	346°	SW-IF	5RW1925-NC-24-R3	NC	3RW0463-00-05-R10	322°		With 085A; not completed
1IX-ILPR 087G	646	302°	SW-IF	5RW1925-NC-24-R3	NC	3RW0463-00-05-R10			Drains with 026G of Elev. 622
1IX-ILPR 088A	622	101° 15'	PW-OF	5RW1925-NC-03-R4	NC	3RW0463-00-03-R8			No drain required
1IX-ILPR 089B	622	107° 30'	PW-OF	5RW1925-NC-03-R4	NC	3RW0463-00-03-R8			No drain required
1IX-ILPR 090A	622	258°	PW-OF	5RW1925-NC-03-R4	NC	3RW0463-00-03-R8			No drain connected
1IX-ILPR 091B	622	210°	PW-OF	5RW1925-NC-03-R4	NC	3RW0463-00-03-R8			No drain required
1IX-ILPR 094E	646	201°	SW-IF	5RW1925-NC-24-R3	NC	3RW0463-00-05-R10			Drain not connected
1IX-ILPR 095	622	116°	DR-OF	5RW0925-ND-95-R0	ND	3RW0463-00-03-R8			Unable to locate; panel not where shown
1IX-ILPR 096G	646	352° 30'	SW-IF	5RW1925-NC-27-R3	NC	3RW0463-00-05-R10			Unable to locate; panel not where shown
1IX-ILPR 097B	622	54° 30'	PW-OF	5RW1925-NC-26-R3	NC	3RW0463-00-02-R7			Unable to locate; panel not where shown
1IX-ILPR 098	646	310°	SW-IF	5RW1925-NC-27-R3	NC	3RW0463-00-05-R10			Unable to locate; panel not where shown

* = Estimated Azimuth

PW = Primary Containment (Crane) Wall

SW = Secondary Containment (Reactor Building Outer) Wall

DR - D-Ring Wall

IN WL = Intermediate Wall

INTER = Intermediate Location

IF = Inner Face

OF = Outer Face

D1 = Closed Drain Connection

F6 = Closed Drain Connection

TABLE 22
BLN HOT INSTRUMENT PANEL TABULATION
SAMPLE SINKS

SAMPLE SINK	ELEV	AREA	SINK DRAWING	SYS	DRAIN DRAWING	DRAIN DETAIL	DRAIN TERMINATION	REMARKS
01X-1XPA 004	610	A6-S	5GW-0941-YQ-26-R8	WG	3AW0462-00-13-R5	DR0040-D2	Tritiated Waste Holdup Tank	Gas analyzer
01X-1XPA 005	610	A6-R	5GW-0941-YQ-26-R8	WG	3AW0462-00-13-R5			Gas analyzer; no drain required
11X-1XPA 008	610	A6-S	5GW-0941-YQ-24-R9	(1)	3AW0462-00-13-R5	DR0040-D2	Tritiated Waste Holdup Tank	Hot sample panel
21X-1XPA 008	610	A9-S	5GW-0941-YQ-24-R9	(1)	3AW0462-00-15-R5		Drain not connected	Hot sample panel
11X-1XPA 009	610	A6-R	5GW-0941-YQ-24-R9	(2)	3AW0462-00-13-R5	DR0041-D2	Tritiated Waste Holdup Tank	Hot sample panel
21X-1XPA 009	610	A9-S	5GW-0941-YQ-24-R9	(2)	3AW0462-00-15-R5		Drain not connected	Hot sample panel

TABLE 23
BLN HOT INSTRUMENT PANEL TABULATION
GRAB SAMPLE STATIONS

STATION	ELEV	AREA	STATION DRAWING	SYS	DRAIN DRAWING	DRAIN DETAIL	DRAIN TERMINATION	REMARKS
0YQ-1YGS 903	590	A 8-S	5GW0941-YQ-21-R7	NB	3AW0462-00-08-R7	DR 1179-02	Tritiated Sump Tank	
0YQ-1YGS 905	610	A 5-U	5GW0941-YQ-21-R7	WL	3AW0462-00-14-R7			No drain
0YQ-1YGS 906	610	A 8-T	5GW0941-YQ-21-R7	WL, NB	3AW0462-00-16-R7	Floor drain A1	Tritiated Waste Holdup Tank	
0YQ-1YGS 907	610	A10-U	5GW0941-YQ-21-R7	WL	3AW0462-00-16-R7			Drain not connected
0YQ-1YGS 908	622	A 9-Y	5GW0941-YQ-21-R7	WL	3AW0462-00-20-R10			No drain
1YQ-1YGS 909	629	A 3-R	5GW0941-YQ-21-R7	KC, ND	3AW0462-00-22-R9	DR 0340-02	Tritiated Waste Holdup Tank	
2YQ-1YGS 909	629	A12-R	5GW0941-YQ-21-R7	KC, ND	3AW0462-00-28-R7			No drain
0YQ-1YGS 910	649	A 5-S	5GW0941-YQ-21-R7	NB	3AW0462-00-31-R8			No drain
0YQ-1YGS 911	649	A 7-R	5GW0941-YQ-21-R7	NB	3AW0462-00-31-R8			No drain
1YQ-1YGS 912	629	A 1-U	5GW0941-YQ-21-R7	NS	3AW0462-00-23-R6			Unable to locate; not where shown
2YQ-1YGS 912	629	A14-U	5GW0941-YQ-21-R7	NS	3AW0462-00-29-R5			Unable to locate; not where shown
0YQ-1YGS 913	610	A 8-V	5GW0941-YQ-21-R7	WL	3AW0462-00-16-R7			Unable to locate; not where shown
0YQ-1YGS 914	622	A 8-Y	5GW0941-YQ-21-R7	WL	3AW0462-00-20-R10			Unable to locate; not where shown
0YG-1YGS 920	590	A 8-S	5GW0941-YQ-21-R7	WL	3AW0462-00-07-R5			Unable to locate; not where shown
0YG-1YGS 921	590	A 7-R	5GW0941-YQ-21-R7	NB	3AW0462-00-05-R5			Sample point - no drain required
1YG-1YGS 922	590	A 7-U	5GW0941-YQ-21-R7	WL	3AW0462-00-06-R7			Sample point - no drain required
2YG-1YGS 922	590	A 8-T	5GW0941-YQ-21-R7	WL	3AW0462-00-08-R7			Unable to locate; not where shown
1YG-1YGS 923	590	A 5-T	5GW0941-YQ-21-R7	WL	3AW0462-00-06-R7			Sample point - no drain required
2YG-1YGS 923	590	A10-T	5GW0941-YQ-21-R7	WL	3AW0462-00-08-R7			Unable to locate; not where shown

TABLE 23
BLN HOT INSTRUMENT PANEL TABULATION
GRAB SAMPLE STATIONS

STATION	ELEV	AREA	STATION DRAWING	SYS	DRAIN DRAWING	DRAIN DETAIL	DRAIN TERMINATION	REMARKS
OYG-IYGS 924	590	A 7-U	5GW0941-YQ-21-R7	WL	3AW0462-00-06-R7			Unable to locate; not where shown
OYG-IYGS 925	590	A 8-U	5GW0941-YQ-21-R7	WL	3AW0462-00-08-R7			Unable to locate; not where shown
OYG-IYGS 926	590	A 8-R	5GW0941-YQ-21-R7	NB	3AW0462-00-07-R5			Unable to locate; not where shown
OYG-IYGS 927	610	A 7-V	5GW0941-YQ-21-R7	WL	3AW0462-00-14-R7			Unable to locate; not where shown
OYG-IYGS 928	610	A 8-V	5GW0941-YQ-21-R7	WL	3AW0462-00-16-R7			Unable to locate; not where shown
OYG-IYGS 929	622	A 7-W	5GW0941-YQ-21-R7	NM	3AW0462-00-19-R4			Drain not connected
OYG-IYGS 930	622	A 8-W	5GW0941-YQ-21-R7	NM	3AW0462-00-19-R4			Drain not connected
OYG-IYGS 931	622	A 8-X	5GW0941-YQ-21-R7	NM	3AW0462-00-20-R10			No drain
OYG-IYGS 932	629	A 6-R	5GW0941-YQ-21-R7	NB	3AW0462-00-24-R4			Unable to locate; not where shown
OYG-IYGS 933	629	A 6-Q	5GW0941-YQ-21-R7	NB	3AW0462-00-24-R4			Unable to locate; not where shown
OYG-IYGS 934	629	A 7-U	5GW0941-YQ-21-R7	NB	3AW0462-00-25-R9			Sample point - no drain required
OYG-IYGS 935	629	A 7-U	5GW0941-YQ-21-R7	WL	3AW0462-00-25-R9			Unable to locate; not where shown
OYG-IYGS 936	629	A 8-U	5GW0941-YQ-21-R7	NB	3AW0462-00-27-R7			Sample point - no drain required
OYG-IYGS 937	649	A 7-V	5GW0941-YQ-21-R7	NB	3AW0462-00-31-R8			2 sample points - no drain required
OYQ-IYGS 971	629	A 6-R	5GW0941-YQ-21-R7	NB	3AW0462-00-24-R4			Unable to locate; not where shown

TABLE 24
SQN SAMPLING PANELS
HOT SAMPLE ROOM

REPORT NUMBER: 22900
REVISION NUMBER: 5
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Panel	Elev	Col	Description	Drawing	Inlet	"Hot"	Outlet	Sampler	Cylinder Bypass	Root Valve Drawing	Root Valve Valve No	Containment Valves Inside	Containment Valves Outside	Isolation Valve	Comments
1A	690	wA5	Cubicle 1A (Panel 1-L-231)	SQN 47W343-2	1. Hot Leg Loop 1	Yes)	Vol Control Tank	Cylinder	Yes	47W465-5 Det A7	W 1-8056	FCV-43-22	FCV-43-23	FCV-43-20	
					Hot Leg Loop 3	Yes)				47W465-6 Det B7	W 1-8077	FCV-43-22	FCV-43-23	FCV-43-21	
					2. Pressurizer Liquid	Yes	Vol Control Tank	Cylinder	Yes	47W465-2 Sec C2	W 1-8080	FCV-43-11	FCV-43-12	FCV-43-10	
					3. Pressurizer Gas	Yes	Vol Control Tank	Cylinder	Yes	47W465-2 Sec A2	W 1-8078	FCV-43-02	FCV-43-03	FCV-43-01	
					4. Vol Control Vent	Yes	Vent Header	Cylinder	No	47W406-2 Sec C2	W 1-8373			FCV-43-05	
					5. Inlet Mix Bed Demin	Yes)	Vol Control Tank	Cylinder	Yes	47W406-2 wA5, A11	W 1-8372				
					6. Outlet Mix Bed Demin	Yes)				47W406-2	W 1-8372				
					7. Inlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-5	Mk 258				
					8. Outlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-14 A14	Mk 307				
					9. CVCS Holdup Tank Recirc	Yes	Drain	Cylinder	Yes	47W555-5	Mk 258				
					10. Tritiated Dr Tank Recirc	Yes	Drain	Cylinder	Yes	47W560-7 C7	1-9219				
							Vol Control Tank			47W406-2	W 1-8372				
2A	690	wA11	Cubicle 2A (Panel 2-L-231)												Same as 1A
1B	690	wA5	Cubicle 1B (Panel 1-L-232)	SQN 47W343-4	1. Outlet Boric Acid Blend	No	Drain via sink	Valve	N/A	47W555-18	1-8431				
					2. Accum Tank Hdr Outlet	No	Drain via sink	Valve	N/A	47W625-2	W 1-8962				
					3. Contmt Drain Sump 1	Yes)	Drain via sink	Valve	N/A	47W625-13	Mk 44				
					Contmt Drain Sump 2	Yes)				47W625-13	Mk 44				
					4. Accum Tanks 1	No)				47W435-6	W 1-8933A	FCV-43-34	FCV-43-35	FCV-43-30	
					Accum Tanks 2	No)	Drain via sink	Valve	N/A	47W435-7	W 1-8933B	FCV-43-34	FCV-43-35	FCV-43-31	
					Accum Tanks 3	No)				47W435-8	W 1-8933C	FCV-43-34	FCV-43-35	FCV-43-32	
					Accum Tanks 4	No)				47W435-9	W 1-8933D	FCV-43-34	FCV-43-35	FCV-43-33	
					5. Steam Gen Blowdown 1	Yes)				47W400-7	Mk 329			FCV-43-55	
					6. Steam Gen Blowdown 2	Yes)	Drain via sink	Valve	N/A	47W400-7	Mk 329			FCV-43-58	
					7. Steam Gen Blowdown 3	Yes)				47W400-7	Mk 329			FCV-43-61	
					8. Steam Gen Blowdown 4	Yes)				47W400-7	Mk 329			FCV-43-64	
2B	690	wA11	Cubicle 2B (Panel 2-L-232)												Same as 1B
1C	690	wA5	Cubicle 1C (Panel 0-L-233)	SQN 47W343-3	1. Upstr Boron Inj Tank 1	Yes	Drain via sink	Valve	N/A	47W435-4 Sec D4	W 1-8910				
					2. Dnstr Boron Inj Tank 1	Yes	Drain via sink	Valve	N/A	47W435-4 Sec A4	W 1-8908				
					3. Upstr Boron Inj Tank 2	Yes	Drain via sink	Valve	N/A	47W435-4 Sec D4	W 2-8910				
					4. Dnstr Boron Inj Tank 2	Yes	Drain via sink	Valve	N/A	47W435-4 Sec B4	W 2-8908				
					5. Upstr RHR Exch 1A	Yes	Drain via sink	Valve	N/A	47W432-1	W 1-8725A				
					6. Upstr RHR Exch 1B	Yes	Drain via sink	Valve	N/A	47W432-1	W 1-8725B				
					7. Upstr RHR Exch 2A	Yes	Drain via sink	Valve	N/A	47W432-1	W 1-8725C				
					8. Upstr RHR Exch 2B	Yes	Drain via sink	Valve	N/A	47W432-1	W 1-8725B				
					9. Wte Evap Cnds Fltr Inlet	Yes	Drain via sink	Valve	N/A	47W560-9 Sec A9	9277A				
					10. Wte Evap Demin Outlet	Yes	Drain via sink	Valve	N/A	47W560-14 Sec C14	9277B				

TABLE 24
SQN SAMPLING PANELS
HOT SAMPLE ROOM

Panel	Elev	Col	Description	Drawing	Inlet	"Hot"	Outlet	Sampler	Cylinder Bypass	Root Valve Drawing	Root Valve Valve No	Containment Valves Inside	Containment Valves Outside	Isolation Valve	Comments
					11. Before Evap Cnds Demin 1	Yes)	Drain via sink	Valve	N/A	47W555-15	W 1-8201				
					12. After Evap Cnds Demin 1	Yes)				47W555-15	W 1-8214				
					13. Before Evap Cnds Demin 2	Yes)	Drain via sink	Valve	N/A	47W555-15	W 2-8201				
					14. After Evap Cnds Demin 2	Yes)				47W555-15	W 2-8214				
					15. SIS Pump Refueling Wtr 2	Yes	Drain via sink	Valve	N/A	47W435-1	W 2-8932				
					16. SIS Pump Refueling Wtr 1	Yes	Drain via sink	Valve	N/A	47W435-1	W 1-8932				
					17. RHR Pp Min Fl Line 1A	Yes)	Drain via sink	Valve	N/A	47W432-1 Pl 690	Mk 308			FCV-43-70	
					RHR Pp Min Fl Line 2B	Yes)				47W432-1 Pl 690	Mk 308			FCV-43-71	
					18. RHR Pp Min Fl Line 2A	Yes)	Drain via sink	Valve	N/A	47W432-1 Pl 690	Mk 308			FCV-43-67	
					RHR Pp Min Fl Line 2B	Yes)				47W432-1 Pl 690	Mk 308			FCV-43-69	
1-C7	690	wA5	Boron Monitor (Panel 1-L-393)	SQN 47W610 -43-1	Dnstr Ltdn Heat Exchgr	Yes)	(Sample Return			47W406-4	Mk 307	--	--	FCV-43-76	
					Dnstr Excess Ltdn HE	Yes)	(Drain			47W406-9	3/4 T 58	FCV-43-75	FCV-43-77		
							Sample Return			47W406-2	W 1-8372				
2-C7	690	wA11	Boron Monitor (Panel 2-L-393												Same as 1-C7
A8	690	wA9	Gas Analyzer Panel (Panel 0-L-206)	Customline Control 4918-1	1. Spare (Capped)	-)				--	--				
					2. CVCS Vol Control Tk 1	Yes)				47W406-2 Sec C2	W 1-8414				
					3. Spent Resin Stg Tk	Yes)				47W560-13 Sec A13	9302				
					4. RCS Press Relief Tk 1	Yes)				47W465-2 Sec A2	W 1-8092	1FCV68308	1FCV68307		
					5. WDS Gas Decay Tk Auto	Yes)				47W560-16	?				
					6. CVCS Holdup Tk 1	Yes)				47W555-6 Sec A6	?				
					7. Spare (Capped)	-)				--	--				
					8. CVCS Holdup Tk 2	Yes)	(Sample Vent	Cylinder	Yes	47W555-6 Sec A6	?				
					9. WDS Gas Decay Tk Man	Yes)	(Drain			47W560-16	?				from Trap
					10. Spare (Capped)	-)				--	--				
					11. Spare (Capped)	-)				--	--				
					12. CVCS Vol Control Tk 2	Yes)				47W406-2 Sec C2	W 2-8414				
					13. RCS Press Relief Tk 2	Yes)				47W465-2 Sec A2	W 2-8092	2FCV68308	2FCV68307		
					14. Spare (Capped)	-)				--	--				
					15. Spare (Capped)	-)				--	--				
					16. Spare (Capped)	-)				--	--				
					17. Purge Air	No				N/A					
					18. Zero Gas	No)	Calib Gas Vent			N/A					
					19. Span Gas	No)				N/A					

N/A = Not Applicable

TABLE 25
WBN HOT SAMPLE ROOM SAMPLING PANELS

Panel	Elev	Col	Description	Drawing	Inlet	"Hot"	Outlet	Sampler	Cylinder Bypass	Root Valve Drawing	Root Valve No	Containment Valves Inside	Containment Valves Outside	Isolation Valve
1A	713	wA5	Cubicle 1A (Panel 1-L-231)	47W625-1	1. Hot Leg Loop 1	Yes)	Vol Control Tank	Cylinder	Yes	47W465-5	1-SMV-68-548-S	1-FCV-43-22	1-FCV-43-23	1-FCV-43-20
					Hot Leg Loop 3	Yes)				47W465-6	1-SMV-68-578-S	1-FCV-43-22	1-FCV-43-23	1-FCV-43-21
					2. Pressurizer Liquid	Yes	Vol Control Tank	Cylinder	Yes	47W465-2	1-SMV-68-575-S	1-FCV-43-11	1-FCV-43-12	1-FCV-43-10
					3. Pressurizer Gas	Yes	Vol Control Tank	Cylinder	Yes	47W465-2	1-SMV-68-576-S	1-FCV-43-02	1-FCV-43-03	1-FCV-43-01
					4. Vol Control Vent	Yes	Vent Header	Cylinder	No	47W406-2	1-SMV-62A-689			1-FCV-43-05
					5. Inlet Mix Bed Demin	Yes)	Vol Control Tank	Cylinder	Yes	47W406-2	1-SMV-62A-674			
					6. Outlet Mix Bed Demin	Yes)				47W406-3	62-677 - See Note 2			
					7. Inlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-5	1-SMV-62-980A			
					8. Outlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-17	1-SMV-62-980B			
					9. CVCS Holdup Tank Recirc	Yes	Drain	Cylinder	Yes	47W555-5	0-SMV-62B-968			
					10. Tritiated Dr Tank Recirc	Yes	Drain	Cylinder	Yes	47W560-7	0-SMV-77-538			
							Vol Control Tank			47W406-2	W 1-8372 - See Note 2			
2A	713	wA11	Cubicle 2A (Panel 2-L-231)	47W625-1	1. Hot Leg Loop 1	Yes)	Vol Control Tank	Cylinder	Yes	47W465-5	2-SMV-68-548	2-FCV-43-22	2-FCV-43-23	2-FCV-43-20
					Hot Leg Loop 3	Yes)				47W465-6	2-SMV-68-578	2-FCV-43-22	2-FCV-43-23	2-FCV-43-21
					2. Pressurizer Liquid	Yes	Vol Control Tank	Cylinder	Yes	47W465-2	2-SMV-68-575	2-FCV-43-11	2-FCV-43-12	2-FCV-43-10
					3. Pressurizer Gas	Yes	Vol Control Tank	Cylinder	Yes	47W465-2	68-576 - See Note 2	2-FCV-43-02	2-FCV-43-03	2-FCV-43-01
					4. Vol Control Vent	Yes	Vent Header	Cylinder	No	47W406-2	2-SMV-62-689			2-FCV-43-05
					5. Inlet Mix Bed Demin	Yes)	Vol Control Tank	Cylinder	Yes	47W406-2	62-674 - See Note 2			
					6. Outlet Mix Bed Demin	Yes)				47W406-3	62-677 - See Note 2			
					7. Inlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-5	2-SMV-62-980A			
					8. Outlet Ion Exchange	Yes	Drain	Cylinder	Yes	47W555-17	2-SMV-62-980B			
							Vol Control Tank			47W406-2	W 2-8372 - See Note 2			
1B	713	wA7	Cubicle 1B (Panel 1-L-232)	47W625-2	1. Outlet Boric Acid Blend	No	Drain via sink	Valve	N/A	47W555-18	1-SMV-62-939			
					2. Accum Tank Hdr Outlet	No	Drain via sink	Valve	N/A	47W435-1	1-SMV-63-600			
					3. (Not Used)									
					4. Accum Tanks 1	No)				47W435-6	1-SMV-63-614-S	1-FCV-43-34	1-FCV-43-35	1-FCV-43-30
					Accum Tanks 2	No)	Drain via sink	Valve	N/A	47W435-7	1-SMV-63-615-S	1-FCV-43-34	1-FCV-43-35	1-FCV-43-31
					Accum Tanks 3	No)				47W435-8	1-SMV-63-616-S	1-FCV-43-34	1-FCV-43-35	1-FCV-43-32
					Accum Tanks 4	No)				47W435-9	1-SMV-63-617-S	1-FCV-43-34	1-FCV-43-35	1-FCV-43-33
					5. Steam Gen Blowdown 1	Yes)				47W400-8	1-836 - See Note 2	1-FCV-43-54D	1-FCV-43-55	1-FCV-43-54A
										47W400-6	1-SMV-1-820	1-FCV-43-54D	1-FCV-43-55	1-FCV-43-54B
					6. Steam Gen Blowdown 2	Yes)	Drain via sink	Valve	N/A	47W400-8	1-837 - See Note 2	1-FCV-43-56D	1-FCV-43-58	1-FCV-43-56A
										47W400-6	1-821 - See Note 3	1-FCV-43-56D	1-FCV-43-58	1-FCV-43-56B
					7. Steam Gen Blowdown 3	Yes)				47W400-8	1-838 - See Note 2	1-FCV-43-59D	1-FCV-43-61	1-FCV-43-59A
										47W400-6	1-822 - See Note 3	1-FCV-43-59D	1-FCV-43-61	1-FCV-43-59B
					8. Steam Gen Blowdown 4	Yes)				47W400-8	1-839 - See Note 2	1-FCV-43-63D	1-FCV-43-64	1-FCV-43-63A
										47W400-6	1-SMV-01B-823	1-FCV-43-63D	1-FCV-43-64	1-FCV-43-63B

TABLE 25
WBN HOT SAMPLE ROOM SAMPLING PANELS

Panel	Elev	Col	Description	Drawing	Inlet	"Hot"	Outlet	Sampler	Cylinder Bypass	Root Valve Drawing	Root Valve No	Containment Valves Inside	Containment Valves Outside	Isolation Valve
2B	713	wA9	Cubicle 2B (Panel 2-L-232)	47W625-2	1. Outlet Boric Acid Blend	No	Drain via sink	Valve	N/A	47W555-18	2-SHV-62-939			
					2. Accum Tank Hdr Outlet	No	Drain via sink	Valve	N/A	47W435-1	63-600 - See Note 2			
					3. (Not Used)									
					4. Accum Tanks 1	No)				47W435-6	2-SHV-63-614	1-FCV-43-34	1-FCV-43-35	1-FCV-43-30
					Accum Tanks 2	No)	Drain via sink	Valve	N/A	47W435-7	2-SHV-63-615	1-FCV-43-34	1-FCV-43-35	1-FCV-43-31
					Accum Tanks 3	No)				47W435-8	2-SHV-63-616	1-FCV-43-34	1-FCV-43-35	1-FCV-43-32
					Accum Tanks 4	No)				47W435-9	2-SHV-63-617	1-FCV-43-34	1-FCV-43-35	1-FCV-43-33
					5. Steam Gen Blowdown 1	Yes)				47W400-8	2-836 - See Note 2	1-FCV-43-54D	1-FCV-43-55	1-FCV-43-54A
										47W400-6	2-SHV-01B-820	1-FCV-43-54D	1-FCV-43-55	1-FCV-43-54B
					6. Steam Gen Blowdown 2	Yes)	Drain via sink	Valve	N/A	47W400-8	2-837 - See Note 2	1-FCV-43-56D	1-FCV-43-58	1-FCV-43-56A
										47W400-6	2-SHV-01B-821	1-FCV-43-56D	1-FCV-43-58	1-FCV-43-56B
					7. Steam Gen Blowdown 3	Yes)				47W400-8	2-838 - See Note 2	1-FCV-43-59D	1-FCV-43-61	1-FCV-43-59A
										47W400-6	2-SHV-01B-822	1-FCV-43-59D	1-FCV-43-61	1-FCV-43-59B
					8. Steam Gen Blowdown 4	Yes)				47W400-8	2-839 - See Note 2	1-FCV-43-63D	1-FCV-43-64	1-FCV-43-63A
										47W400-6	2-SHV-01B-823	1-FCV-43-63D	1-FCV-43-64	1-FCV-43-63B
1C	713	wA7	Cubicle 1C (Panel 0-L-233)	47W625-3	1. Dnstr Boron Inj Tank 1	Yes	Drain via sink	Valve	N/A					
					2. Upstr Boron Inj Tank 1	Yes	Drain via sink	Valve	N/A	47W435-4	63-578 - See Note 1			
					3. Dnstr Boron Inj Tank 2	Yes	Drain via sink	Valve	N/A	47W435-4	1-SHV-63-569A			
					4. Upstr Boron Inj Tank 2	Yes	Drain via sink	Valve	N/A	47W435-4	2-SHV-63-578			
					5. Upstr RHR Exch 1A	Yes	Drain via sink	Valve	N/A	47W435-4	2-SHV-63-569			
					6. Upstr RHR Exch 1B	Yes	Drain via sink	Valve	N/A	47W432-1	1-SHV-74-522			
					7. Upstr RHR Exch 2A	Yes	Drain via sink	Valve	N/A	47W432-1	1-SHV-74-523B			
					8. Upstr RHR Exch 2B	Yes	Drain via sink	Valve	N/A	47W432-1	2-SHV-74-522			
					9. Wte Evap Cnds Fltr Inlet	Yes	Drain via sink	Valve	N/A	47W432-1	2-SHV-74-523			
					10. Wte Evap Demin Outlet	Yes	Drain via sink	Valve	N/A	47W560-9	0-SHV-77-560			
					11. Before Evap Cnds Demin 1	Yes)	Drain via sink	Valve	N/A	47W560-14	0-SHV-77-588			
					12. After Evap Cnds Demin 1	Yes)				47W555-15	1-SHV-62B-989			
					13. Before Evap Cnds Demin 2	Yes)	Drain via sink	Valve	N/A	47W555-15	1-SHV-62B-1000			
					14. After Evap Cnds Demin 2	Yes)				47W555-15	2-SHV-62B-989			
					15. SIS Pump Refueling Wtr 2	Yes	Drain via sink	Valve	N/A	47W555-15	2-SHV-62B-1000			
					16. SIS Pump Refueling Wtr 1	Yes	Drain via sink	Valve	N/A	47W435-1	1-SHV-63-532			
					17. RHR Pp Min Fl Line 1A	Yes)	Drain via sink	Valve	N/A	47W435-1	63-532 - See Note 2			
					RHR Pp Min Fl Line 1B	Yes)				47W432-1	74-532 - See Note 2			1-FCV-43-70
					18. RHR Pp Min Fl Line 2A	Yes)	Drain via sink	Valve	N/A	47W432-1	74-533 - See Note 2			1-FCV-43-71
					RHR Pp Min Fl Line 2B	Yes)				47W432-1	2-SHV-74-532			2-FCV-43-67
										47W432-1	2-SHV-74-533			2-FCV-43-69
1-C7	690	wA5	Boron Monitor	47W625-7	Dnstr Ltdn Heat Exchgr	Yes)	(Sample Return							
			(Panel 1-L-393)		Dnstr Excess Ltdn HE	Yes)	(Drain			47W406-4	1-SHV-62A-668	--	--	1-FCV-43-76
							Sample Return			47W406-9	1-ISV-62-656	1-FCV-43-75	1-FCV-43-77	
										47W406-2	1-SHV-62A-685			

TABLE 25
WBN HOT SAMPLE ROOM SAMPLING PANELS

Panel	Elev	Col	Description	Drawing	Inlet	"Hot"	Outlet	Sampler	Cylinder Bypass	Root Valve Drawing	Root Valve Valve No	Containment Valves Inside	Containment Valves Outside	Isolation Valve
2-C7	690	wA11	Boron Monitor	47W625-7	Dnstr Ltdn Heat Exchgr	Yes)	(Sample Return			47W406-4	62-668 - See Note 3	--	--	2-FCV-43-76
			(Panel 2-L-393)		Dnstr Excess Ltdn HX	Yes)	(Drain			47W406-9	2-SMV-62A-656	2-FCV-43-75	2-FCV-43-77	
							Sample Return			47W406-2	2-SMV-62A-685			
A8	690	wA9	Gas Analyzer Panel	47W625-8	1. React Coolnt Drn Tk 1	Yes)				47W560-4	77-510 - See Note 2			
			(Panel 0-L-206)	and Comsip	2. CVCS Vol Control Tk 1	Yes)				47W406-2	1-SMV-62A-687			
				Customline	3. Spent Resin Stg Tk	Yes)				47W560-13	9302 - See Note 2			
				5B88-4	4. RCS Press Relief Tk 1	Yes)				47W465-2	1-ISV-68-574	1-FCV-68-308	1-FCV-68-307	
					5. WDS Gas Decay Tk Auto	Yes)				47W560-16	0-PCV-77-103			
					6. CVCS Holdup Tk 1A	Yes)				47W555-6	1-ISV-62B-956			
					7. Spare (Capped)	-)				--	--			
					8. CVCS Holdup Tk 2	Yes)	(Sample Vent	Cylinder	Yes	47W555-6	2-ISV-62B-956			
					9. WDS Gas Decay Tk Man	Yes)	(Drain			47W560-16	PCV-77-118 - See Note 2			
					10. CVCS Boric Acid Evap 1	Yes)				47W555-7	62-1064 - See Note 2			
					11. React Coolnt Drn Tk 2	Yes)				47W560-4	77-510 - See Note 2			
					12. CVCS Vol Control Tk 2	Yes)				47W406-2	2-ISV-62A-687			
					13. RCS Press Relief Tk 2	Yes)				47W465-2	2-ISV-68-574	2-FCV-68-308	2-FCV-68-307	
					14. CVCS Boric Acid Evap 2	Yes)				47W555-7	62-1064 - See Note 2			
					15. Spare (Capped)	-)				--	--			
					16. Spare (Capped)	-)				--	--			
					17. Purge Air	No				N/A				
					18. Zero Gas	No)	Calib Gas Vent			N/A				
					19. Span Gas	No)				N/A				

Note 1 - Valve number per drawing; valve located, tag not visible
Note 2 - Valve number per drawing; valve not located
Note 3 - Valve number per drawing; valve located, tag missing

N/A = Not Applicable

TABLE 26

SQN DIESEL GENERATOR BUILDING SWITCHES

Instrument	Application	Make	Model	Contact Type
LS-18-38A	Storage Tank 1A-A	GE/MAC	560	Dry
LS-18-38B	Storage Tank 1A-A	GE/MAC	560	Dry
LS-18-38C	Storage Tank 1A-A	GE/MAC	560	Dry
LS-18-38D	Storage Tank 1A-A	GE/MAC	560	Dry
LS-18-39A	Storage Tank 2A-A	GE/MAC	560	Dry
LS-18-39B	Storage Tank 2A-A	GE/MAC	560	Dry
LS-18-39C	Storage Tank 2A-A	GE/MAC	560	Dry
LS-18-39D	Storage Tank 2A-A	GE/MAC	560	Dry
LS-18-40A	Storage Tank 1B-B	GE/MAC	560	Dry
LS-18-40B	Storage Tank 1B-B	GE/MAC	560	Dry
LS-18-40C	Storage Tank 1B-B	GE/MAC	560	Dry
LS-18-40D	Storage Tank 1B-B	GE/MAC	560	Dry
LS-18-41A	Storage Tank 2B-B	GE/MAC	560	Dry
LS-18-41B	Storage Tank 2B-B	GE/MAC	560	Dry
LS-18-41C	Storage Tank 2B-B	GE/MAC	560	Dry
LS-18-41D	Storage Tank 2B-B	GE/MAC	560	Dry
LS-18-62A/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/1	Day Tank 1	Gems	Kit 24576	Dry*

* Instruments are mounted inside the Fuel Oil Day Tank. Vendor prints were used for verification. The number 24576 is the Gems "Fabri-Level" switch kit part number.

TABLE 26 (cont'd)

Instrument	Application	Make	Model	Contact Type
LS-18-64B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-77A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/4	Day Tank 2	Gems	Kit 24576	Dry*
PS-18-66A/1	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66A/2	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66A/3	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66A/4	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66B/1	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66B/2	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66B/3	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-66B/4	Fuel Pump 1	Barksdale	E1H-H90	Dry
PS-18-70/1	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-70/2	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-70/3	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-70/4	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-81A/1	Fuel Pump 2	Barksdale	E1H-H90	Dry

* Instruments are mounted inside the Fuel Oil Day Tank. Vendor prints were us[ed] for verification. The number 24576 is the Gems "Fabri-Level" switch kit part number.

TABLE 26 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-18-81A/2	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81A/3	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81A/4	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81B/1	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81B/2	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81B/3	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-81B/4	Fuel Pump 2	Barksdale	E1H-H90	Dry
PS-18-85/1	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-85/2	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-85/3	Fuel Header	Barksdale	E1H-H90	Dry
PS-18-85/4	Fuel Header	Barksdale	E1H-H90	Dry
PS-82-160	Starting Air Engine 1A1	Barksdale	E1H-H90	Dry
PS-82-161	Starting Air Engine 1A2	Barksdale	E1H-H90	Dry
PS-82-162	Starting Air Engine 1A1	Barksdale	E1H-250	Dry
PS-82-163	Starting Air Engine 1A2	Barksdale	E1H-250	Dry
PS-82-164	Starting Air Tank Engine 1A1	Barksdale	E1H-500	Dry
PS-82-165	Starting Air Tank Engine 1A2	Barksdale	E1H-500	Dry
PS-82-170	Starting Air SPTK Engine 1A1	Barksdale	E1H-H90	Dry
PS-82-171	Starting Air SPTK Engine 1A2	Barksdale	E1H-H90	Dry
PS-82-172	Starting Air SPTK Engine 1A1	Barksdale	E1H-250	Dry
PS-82-173	Starting Air SPTK Engine 1A2	Barksdale	E1H-250	Dry
PS-82-174	Starting Air SPTK Engine 1A1	Barksdale	E1H-500	Dry
PS-82-175	Starting Air SPTK Engine 1A2	Barksdale	E1H-500	Dry
PS-82-180	Compressor Engine 1A1	Square D	ASG	Dry
PS-82-181	Compressor Engine 1A2	Square D	ASG	Dry
PS-82-182	Air Dryer Engine 1A1	Pall Trinity		Dry+
PS-82-183	Air Dryer Engine 1A2	Pall Trinity		Dry+
PS-82-190	Starting Air Engine 1B1	Barksdale	E1H-H90	Dry
PS-82-191	Starting Air Engine 1B2	Barksdale	E1H-H90	Dry
PS-82-192	Starting Air Engine 1B1	Barksdale	E1H-H250	Dry
PS-82-193	Starting Air Engine 1B2	Barksdale	E1H-H250	Dry
PS-82-194	Starting Air Tank Engine 1B1	Barksdale	E1H-H500	Dry
PS-82-195	Starting Air Tank Engine 1B2	Barksdale	E1H-H500	Dry
PS-82-200	Starting Air SPTK Engine 1B1	Barksdale	E1H-H90	Dry
PS-82-201	Starting Air SPTK Engine 1B2	Barksdale	E1H-H90	Dry
PS-82-202	Starting Air SPTK Engine 1B1	Barksdale	E1H-H250	Dry
PS-82-203	Starting Air SPTK Engine 1B2	Barksdale	E1H-H250	Dry
PS-82-204	Starting Air SPTK Engine 1B1	Barksdale	E1H-H500	Dry
PS-82-205	Starting Air SPTK Engine 1B2	Barksdale	E1H-H500	Dry
PS-82-210	Compressor Engine 1B1	Square D	ASG	Dry
PS-82-211	Compressor Engine 1B2	Square D	ASG	Dry
PS-82-212	Air Dryer Engine 1B1	Pall Trinity		Dry+

TABLE 26 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-82-213	Air Dryer Engine 1B2	Pall Trinity		Dry+
PS-82-220	Starting Air Engine 2A1	Barksdale	E1H-H90	Dry
PS-82-221	Starting Air Engine 2A2	Barksdale	E1H-H90	Dry
PS-82-222	Starting Air Engine 2A1	Barksdale	E1H-H250	Dry
PS-82-223	Starting Air Engine 2A2	Barksdale	E1H-H250	Dry
PS-82-224	Starting Air Tank Engine 2A1	Barksdale	E1H-H500	Dry
PS-82-225	Starting Air Tank Engine 2A2	Barksdale	E1H-H500	Dry
PS-82-230	Starting Air SPTK Engine 2A1	Barksdale	E1H-H90	Dry
PS-82-231	Starting Air SPTK Engine 2A2	Barksdale	E1H-H90	Dry
PS-82-232	Starting Air SPTK Engine 2A1	Barksdale	E1H-H250	Dry
PS-82-233	Starting Air SPTK Engine 2A2	Barksdale	E1H-H250	Dry
PS-82-234	Starting Air SPTK Engine 2A1	Barksdale	E1H-H500	Dry
PS-82-235	Starting Air SPTK Engine 2A2	Barksdale	E1H-H500	Dry
PS-82-240	Compressor Engine 2A1	Square D	ASG	Dry
PS-82-241	Compressor Engine 2A2	Square D	ASG	Dry
PS-82-242	Air Dryer Engine 2A1	Pall Trinity		Dry+
PS-82-243	Air Dryer Engine 2A2	Pall Trinity		Dry+
PS-82-250	Starting Air Engine 2B1	Barksdale	E1H-H90	Dry
PS-82-251	Starting Air Engine 2B2	Barksdale	E1H-H90	Dry
PS-82-252	Starting Air Engine 2B1	Barksdale	E1H-H250	Dry
PS-82-253	Starting Air Engine 2B2	Barksdale	E1H-H250	Dry
PS-82-254	Starting Air Tank Engine 2B1	Barksdale	E1H-H500	Dry
PS-82-255	Starting Air Tank Engine 2B2	Barksdale	E1H-H500	Dry
PS-82-260	Starting Air SPTK Engine 2B1	Barksdale	E1H-H90	Dry
PS-82-261	Starting Air SPTK Engine 2B2	Barksdale	E1H-H90	Dry
PS-82-262	Starting Air SPTK Engine 2B1	Barksdale	E1H-H250	Dry
PS-82-263	Starting Air SPTK Engine 2B2	Barksdale	E1H-H250	Dry
PS-82-264	Starting Air SPTK Engine 2B1	Barksdale	E1H-H500	Dry
PS-82-265	Starting Air SPTK Engine 2B2	Barksdale	E1H-H500	Dry
PS-82-270	Compressor Engine 2B1	Square D	ASG	Dry
PS-82-271	Compressor Engine 2B2	Square D	ASG	Dry
PS-82-272	Air Dryer Engine 2B1	Pall Trinity		Dry+
PS-82-273	Air Dryer Engine 2B2	Pall Trinity		Dry+
PS-82-328	Lube Oil Engine 1A1	Ashcroft	B424	Dry
PS-82-329	Lube Oil Engine 1A2	Ashcroft	B424	Dry
PS-82-330	Lube Oil Engine 1B1	Ashcroft	B424	Dry
PS-82-331	Lube Oil Engine 1B2	Ashcroft	B424	Dry
PS-82-332	Lube Oil Engine 2A1	Ashcroft	B424	Dry

\+ These instruments are an integral part of the PTM air dryer controller. model number is given.

TABLE 26 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-82-333	Lube Oil Engine 2A2	Ashcroft	B424	Dry
PS-82-334	Lube Oil Engine 2B1	Ashcroft	B424	Dry
PS-82-335	Lube Oil Engine 2B2	Ashcroft	B424	Dry
PS-82-336	Lube Oil Engine 1A1	Ashcroft	B424	Dry
PS-82-337	Lube Oil Engine 1A2	Ashcroft	B424	Dry
PS-82-338	Lube Oil Engine 1B1	Ashcroft	B424	Dry
PS-82-339	Lube Oil Engine 1B2	Ashcroft	B424	Dry
PS-82-340	Lube Oil Engine 2A1	Ashcroft	B424	Dry
PS-82-341	Lube Oil Engine 2A2	Ashcroft	B424	Dry
PS-82-342	Lube Oil Engine 2B1	Ashcroft	B424	Dry
PS-82-343	Lube Oil Engine 2B2	Ashcroft	B424	Dry
PS-82-344	Lube Oil Engine 1A1	Ashcroft	B424	Dry
PS-82-345	Lube Oil Engine 1A2	Ashcroft	B424	Dry
PS-82-346	Lube Oil Engine 1B1	Ashcroft	B424	Dry
PS-82-347	Lube Oil Engine 1B2	Ashcroft	B424	Dry
PS-82-348	Lube Oil Engine 2A1	Ashcroft	B424	Dry
PS-82-349	Lube Oil Engine 2A2	Ashcroft	B424	Dry
PS-82-350	Lube Oil Engine 2B1	Ashcroft	B424	Dry
PS-82-351	Lube Oil Engine 2B2	Ashcroft	B424	Dry
PS-39-50	CO_2 DG Electrical Board Room 2A-A	Cardox	41644	Dry
PS-39-51	CO_2 Fuel Oil Pump Room	Cardox	41644	Dry
PS-39-52	CO_2 DG Electrical Board Room 1A-A	Cardox	41644	Dry
PS-39-55	CO_2 DG Electrical Board Room 1B-B	Cardox	41644	Dry
PS-39-56	CO_2 DG Electrical Board Room 2B-B	Cardox	41644	Dry
LIS-39-36	CO_2 Central Unit	Barton	288A	Dry
PS-39-37A	CO_2 Central Unit	Allen-Bradley	836-P17	Dry
PS-39-37B	CO_2 Central Unit	Allen-Bradley	836-AL32	Dry
PS-39-37C	CO_2 Central Unit	Mercoid	DS7221	Dry
PS-39-37D	CO_2 Central Unit	Allen-Bradley	836-H33	Dry
PS-39-40	CO_2 Lube Oil Storage Room	Cardox	41644	Dry
PS-39-41	CO_2 Diesel Generator Room 1A-A	Cardox	41644	Dry
PS-39-42	CO_2 Diesel Generator Room 2A-A	Cardox	41644	Dry
PS-39-43	CO_2 Diesel Generator Room 1B-B	Cardox	41644	Dry
PS-39-32	CO_2 DG Electrical Board Room 2B-B	Pyle-Nat	ERDC-21	Dry
PS-39-33	CO_2 DG Electrical Board Room 1B-B	Pyle-Nat	ERDC-21	Dry
PS-39-34A	CO_2 DG Electrical Board Room 2A-A	Pyle-Nat	ERDC-21	Dry
PS-39-34B	CO_2 DG Electrical Board Room 1A-A	Pyle-Nat	ERDC-21	Dry
PS-39-44	CO_2 Diesel Generator Room 2B-B	Cardox	41644	Dry
PS-26-168	Sprinkler Control	Barksdale	E1H-B15	Dry

TABLE 26 (cont'd)

The following instruments of the Diesel Generator Lube Oil System are not listed in the Instrument Tabulation and could not be physically located. The information was obtained from vendor prints and calibration records. (Typical for each generator set)

Instrument	Application	Make	Model	Contact Type
TS-82-5001	Lube Oil System	Square D	9025	Dry
TS-82-5002	Lube Oil System	Square D	9025	Dry
TS-82-5003	Lube Oil System	Fenwall	7106	Dry
TS-82-5004	Lube Oil System	Square D	9025	Dry
TS-82-5005	Lube Oil System	Square D	9025	Dry
TS-82-5006	Lube Oil System	Fenwall	7106	Dry
TS-82-5007	Lube Oil System	Square D	9025	Dry
TS-82-5008	Lube Oil System	Square D	9025	Dry
TS-82-5016	Lube Oil System	Telmar	540	Dry
TS-82-5017	Lube Oil System	Telmar	540	Dry
TS-82-5018	Lube Oil System	Telmar	540	Dry
PS-82-5019	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5020	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5021	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5022	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5023	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5024	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5025	Lube Oil System	GM	PM-526	Dry
PS-82-5026	Lube Oil System	GM	PM-526	Dry
PS-82-5027	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5028	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5029	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5030	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5031	Lube Oil System	Square D	AMW3	Dry
PS-82-5032	Lube Oil System	Square D	AMW3	Dry
PS-82-5033	Lube Oil System	Barksdale	E1H-H90	Dry
PS-82-5034	Lube Oil System	Barksdale	E1H-H90	Dry

TABLE 27

WBN DIESEL GENERATOR BUILDING SWITCHES

Instrument	Application	Make	Model	Contact Type
LS-18-38A	Storage Tank 1A-A	Robert Shaw	554C2B2	Dry
LS-18-38B	Storage Tank 1A-A	Robert Shaw	554C2B2	Dry
LS-18-38C	Storage Tank 1A-A	Robert Shaw	554C2B2	Dry
LS-18-38D	Storage Tank 1A-A	Robert Shaw	554C2B2	Dry
LS-18-39A	Storage Tank 2A-A	Robert Shaw	554C2B2	Dry
LS-18-39B	Storage Tank 2A-A	Robert Shaw	554C2B2	Dry
LS-18-39C	Storage Tank 2A-A	Robert Shaw	554C2B2	Dry
LS-18-39D	Storage Tank 2A-A	Robert Shaw	554C2B2	Dry
LS-18-40A	Storage Tank 1B-B	Robert Shaw	554C2B2	Dry
LS-18-40B	Storage Tank 1B-B	Robert Shaw	554C2B2	Dry
LS-18-40C	Storage Tank 1B-B	Robert Shaw	554C2B2	Dry
LS-18-40D	Storage Tank 1B-B	Robert Shaw	554C2B2	Dry
LS-18-41A	Storage Tank 2B-B	Robert Shaw	554C2B2	Dry
LS-18-41B	Storage Tank 2B-B	Robert Shaw	554C2B2	Dry
LS-18-41C	Storage Tank 2B-B	Robert Shaw	554C2B2	Dry
LS-18-41D	Storage Tank 2B-B	Robert Shaw	554C2B2	Dry

The above level switches are located in Panel 0-R-144 remote from the Diesel Generator Building.

Instrument	Application	Make	Model	Contact Type
LS-18-62A/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-62B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-63B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/1	Day Tank 1	Gems	Kit 24576	Dry*

* Instruments are mounted inside the Fuel Oil Day Tank. Vendor prints were used for verification. The number 24576 is the Gems "Fabri-Level" switch kit part number.

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
LS-18-64A/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64A/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/1	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/2	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/3	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-64B/4	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-77A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-77B/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-78B/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79A/4	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/1	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/2	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/3	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-79B/4	Day Tank 2	Gems	Kit 24576	Dry*
PS-18-66A/1	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66A/2	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66A/3	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66A/4	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66B/1	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66B/2	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-66B/3	Fuel Pump 1	Barksdale	E1H-M15	Dry

* Instruments are mounted inside the Fuel Oil Day Tank. Vendor prints were used for verification. The number 24576 is the Gems "Fabri-Level" switch kit part number.

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-18-66B/4	Fuel Pump 1	Barksdale	E1H-M15	Dry
PS-18-70/1	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-70/2	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-70/3	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-70/4	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-81A/1	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81A/2	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81A/3	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81A/4	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81B/1	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81B/2	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81B/3	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-81B/4	Fuel Pump 2	Barksdale	E1H-M15	Dry
PS-18-85/1	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-85/2	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-85/3	Fuel Header	Barksdale	E1H-M90	Dry
PS-18-85/4	Fuel Header	Barksdale	E1H-M90	Dry
PS-82-160	Starting Air Engine 1A1	Barksdale	E1H-M15	Dry
PS-82-161	Starting Air Engine 1A2	Barksdale	E1H-M15	Dry
PS-82-162	Starting Air Tank Engine 1A1	Barksdale	E1H-M250	Dry
PS-82-163	Starting Air Tank Engine 1A2	Barksdale	E1H-M250	Dry
PS-82-164	Starting Air Tank Engine 1A1	Barksdale	E1H-M500	Dry
PS-82-165	Starting Air Tank Engine 1A2	Barksdale	E1H-M500	Dry
PS-82-170	Starting Air Engine 1A1	Barksdale	E1H-M15	Dry
PS-82-171	Starting Air Engine 1A2	Barksdale	E1H-M15	Dry
PS-82-172	Starting Air SPTK Engine 1A1	Barksdale	E1H-M250	Dry
PS-82-173	Starting Air SPTK Engine 1A2	Barksdale	E1H-M250	Dry
PS-82-174	Starting Air SPTK Engine 1A1	Barksdale	E1H-M500	Dry
PS-82-175	Starting Air SPTK Engine 1A2	Barksdale	E1H-M500	Dry
PS-82-180	Compressor Engine 1A1	Square D	ACW2	Dry
PS-82-181	Compressor Engine 1A2	Square D	ACW2	Dry
PS-82-190	Starting Air Engine 1B1	Barksdale	E1H-M15	Dry
PS-82-191	Starting Air Engine 1B2	Barksdale	E1H-M15	Dry
PS-82-192	Starting Air Tank Engine 1B1	Barksdale	E1H-M250	Dry
PS-82-193	Starting Air Tank Engine 1B2	Barksdale	E1H-M250	Dry
PS-82-194	Starting Air Tank Engine 1B1	Barksdale	E1H-M500	Dry
PS-82-195	Starting Air Tank Engine 1B2	Barksdale	E1H-M500	Dry
PS-82-200	Starting Air Engine 1B1	Barksdale	E1H-M15	Dry
PS-82-201	Starting Air Engine 1B2	Barksdale	E1H-M15	Dry
PS-82-202	Starting Air SPTK Engine 1B1	Barksdale	E1H-M250	Dry
PS-82-203	Starting Air SPTK Engine 1B2	Barksdale	E1H-M250	Dry

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-82-204	Starting Air SPTK Engine 1B1	Barksdale	E1H-M500	Dry
PS-82-205	Starting Air SPTK Engine 1B2	Barksdale	E1H-M500	Dry
PS-82-210	Compressor Engine 1B1	Square D	ACW2	Dry
PS-82-211	Compressor Engine 1B2	Square D	ACW2	Dry
PS-82-220	Starting Air Engine 2A1	Barksdale	E1H-M15	Dry
PS-82-221	Starting Air Engine 2A2	Barksdale	E1H-M15	Dry
PS-82-222	Starting Air Tank Engine 2A1	Barksdale	E1H-M250	Dry
PS-82-223	Starting Air Tank Engine 2A2	Barksdale	E1H-M250	Dry
PS-82-224	Starting Air Tank Engine 2A1	Barksdale	E1H-M500	Dry
PS-82-225	Starting Air Tank Engine 2A2	Barksdale	E1H-M500	Dry
PS-82-230	Starting Air Engine 2A1	Barksdale	E1H-M15	Dry
PS-82-231	Starting Air Engine 2A2	Barksdale	E1H-M15	Dry
PS-82-232	Starting Air SPTK Engine 2A1	Barksdale	E1H-M250	Dry
PS-82-233	Starting Air SPTK Engine 2A2	Barksdale	E1H-M250	Dry
PS-82-234	Starting Air SPTK Engine 2A1	Barksdale	E1H-M500	Dry
PS-82-235	Starting Air SPTK Engine 2A2	Barksdale	E1H-M500	Dry
PS-82-240	Compressor Engine 2A1	Square D	ACW2	Dry
PS-82-241	Compressor Engine 2A2	Square D	ACW2	Dry
PS-82-250	Starting Air Engine 2B1	Barksdale	E1H-M15	Dry
PS-82-251	Starting Air Engine 2B2	Barksdale	E1H-M15	Dry
PS-82-252	Starting Air Tank Engine 2B1	Barksdale	E1H-M250	Dry
PS-82-253	Starting Air Tank Engine 2B2	Barksdale	E1H-M250	Dry
PS-82-254	Starting Air Tank Engine 2B1	Barksdale	E1H-M500	Dry
PS-82-255	Starting Air Tank Engine 2B2	Barksdale	E1H-M500	Dry
PS-82-260	Starting Air Engine 2B1	Barksdale	E1H-M15	Dry
PS-82-261	Starting Air Engine 2B2	Barksdale	E1H-M15	Dry
PS-82-262	Starting Air SPTK Engine 2B1	Barksdale	E1H-M250	Dry
PS-82-263	Starting Air SPTK Engine 2B2	Barksdale	E1H-M250	Dry
PS-82-264	Starting Air SPTK Engine 2B1	Barksdale	E1H-H500	Dry
PS-82-265	Starting Air SPTK Engine 2B2	Barksdale	E1H-H500	Dry
PS-82-270	Compressor Engine 2B1	Square D	ACW2	Dry
PS-82-271	Compressor Engine 2B2	Square D	ACW2	Dry
PS-39-50	CO_2 DG Electrical Board Room 2A-A	Cardox	41644	Dry
PS-39-51	CO_2 Fuel Oil Pump Room	(No switch installed)+		
PS-39-52	CO_2 DG Electrical Board Room 1A-A	Cardox	41644	Dry
PS-39-55	CO_2 DG Electrical Board Room 1B-B	Cardox	41644	Dry
PS-39-56	CO_2 DG Electrical Board Room 2B-B	Cardox	41644	Dry
LIS-39-36	CO_2 Central Unit	(unid'able)	0227	Dry
PS-39-37A	CO_2 Central Unit	Allen-Bradley	836-P17	Dry

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-39-37B	CO_2 Central Unit	Allen-Bradley	836	Dry
PS-39-37C	CO_2 Central Unit	Mercoid/ D9-7241-153 R21E		Dry
PS-39-37D	CO_2 Central Unit	Allen-Bradley	836	Dry
PS-39-40	CO_2 Lube Oil Storage Room	Pyle-Nat	ERDC-21+	Dry
PS-39-41	CO_2 Diesel Generator Room 1A-A	Pyle-Nat	ERDC-21+	Dry
PS-39-42	CO_2 Diesel Generator Room 2A-A	Pyle-Nat	ERDC-21+	Dry
PS-39-43	CO_2 Diesel Generator Room 1B-B	Pyle-Nat	ERDC-21+	Dry
PS-39-44	CO_2 Diesel Generator Room 2B-B	Pyle-Nat	ERDC-21+	Dry
PS-26-168	Sprinkler Control	UEC	J302	Dry

+ Instrument tabulations lists these switches as "Cardox Model 41644 approved substitute."

LS-18-90A-S	Storage Tank	Robert Shaw	554-C2-B2	Dry
LS-18-90B-S	Storage Tank	Robert Shaw	554-C2-B2	Dry
LS-18-90D-S	Storage Tank	Robert Shaw	554-C2-B2	Dry

The above level switches are located in panel 0-R-144, remote from the diesel generator room.

LS-18-100A-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-100B-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-100D-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-100E-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-100F-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-100G-S	Day Tank 1	Gems	Kit 24576	Dry*
LS-18-104A-S	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-104B-s	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-104D-S	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-104E-S	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-104F-S	Day Tank 2	Gems	Kit 24576	Dry*
LS-18-104G-S	Day Tank 2	Gems	Kit 24576	Dry*

* Instruments are mounted inside the fuel oil day tanks. Vendor prints were used for verification. The number 24576 is the Gems "Fabri-Level" switch kit part number.

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
PS-18-101A-S	Fuel Pump 1	Ashcroft	B424	Dry
PS-18-101B-S	Fuel Pump 1	Ashcroft	B424	Dry
PS-18-103-S	Fuel Header 1	Ashcroft	B424	Dry
PS-18-105A-S	Fuel Pump 2	Ashcroft	B424	Dry
PS-18-105B-S	Fuel Pump 2	Ashcroft	B424	Dry
PS-18-107-S	Fuel Header 2	Ashcroft	B424	Dry
PS-82-300	Starting Air - Engine 1	Ashcroft	B424	Dry
PS-82-301	Starting Air - Engine 2	Ashcroft	B424	Dry
PS-82-302	Starting Air - Tank 2	Ashcroft	B424	Dry
PS-82-303	Starting Air - Tank 2	Ashcroft	B424	Dry
PS-82-304	Starting Air - Tank 1	Ashcroft	B424	Dry
PS-82-305	Starting Air - Tank 1	Ashcroft	B424	Dry
PS-82-310	Starting Air - Engine 1	Ashcroft	B424	Dry
PS-82-311	Starting Air - Engine 2	Ashcroft	B424	Dry
PS-82-312	Starting Air - SPTK 2	Ashcroft	B424	Dry
PS-82-313	Starting Air - SPTK 2	Ashcroft	B424	Dry
PS-82-314	Starting Air - SPTK 1	Ashcroft	B424	Dry
PS-82-315	Starting Air - SPTK 1	Ashcroft	B424	Dry
PS-82-320	Compressor - Engine 1	Square D	ACW2	Dry
PS-82-321	Compressor - Engine 2	Square D	ACW2	Dry
PS-26-263	Sprinkler Control	Barksdale	E1H-B15	Dry
PS-26-311	Header Air	Robert Shaw	SP211-C09	Dry

The following instruments of the diesel generator lube oil system were identified by physical walkdown of the Diesel Generator Buildings:

IPS-82-319/1A1-A	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-319/2A2-A	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-319/1B1-B	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-319/2B2-B	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-320/1A1-A	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-320/2A2-A	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-320/1B1-B	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-320/2B2-B	Turbine Soakback	Ashcroft	B424	Dry
IPS-82-321/1A1	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-321/2A1	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-321/1B1	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-321/2B2	To Engine Alarm	Barksdale	E1H-M90	Dry

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
IPS-82-322/1A2	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-322/2A2	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-322/1B1	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-322/2B1	To Engine Alarm	Barksdale	E1H-M90	Dry
IPS-82-323/1A2	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-323/2A2	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-323/1B2	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-323/2B2	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-324/1A1	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-324/2A1	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-324/1B1	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-324/2B1	To Engine Shutdown	Barksdale	E1H-M90	Dry
IPS-82-325/1A2	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-325/2A2	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-325/1B2	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-325/2B2	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-326/1A1	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-326/2A1	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-326/1B1	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-326/2B1	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-327/1A1	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-327/2A1	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-327/1B1	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-327/2B1	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-328/1A2	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-328/2A2	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-328/1B2	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-328/2B2	Lo Alarm	Barksdale	E1H-M90	Dry
IPS-82-329/1A2	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-329/2A2	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-329/1B2	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-329/2B2	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-330/1A1	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-330/2A1	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-330/1B1	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-330/2B1	Lo Engine Idle	Barksdale	E1H-M90	Dry
IPS-82-331/1A1-A	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-331/2A1-A	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-331/1B1-B	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-331/2B1-B	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-332/1A2-A	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-332/2A2-A	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-332/1B2-B	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-332/2B2-B	Hi Air Intake Alarm	Square D	AMW3	Dry

TABLE 27 (cont'd)

Instrument	Application	Make	Model	Contact Type
IPS-82-333/1A1	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-333/2A1	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-333/1B1	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-333/2B1	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-334/1A2	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-334/2A2	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-334/1B2	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-334/2B2	Start Cutoff Backup	Barksdale	E1H-M90	Dry
IPS-82-337/1A1-A	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-337/2A1-A	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-337/1B1-B	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-337/2B1-B	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-338/1A2-A	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-338/2A2-A	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-338/1B2-B	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-338/2B2-B	Circulating Oil Alarm	Ashcroft	B424	Dry
IPS-82-BCPA/1A1-A	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPA/2A1-A	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPA/1B1-B	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPA/2B1-B	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPB/1A2-A	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPB/2A2-A	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPB/1B2-B	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-BCPB/2B2-B	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-5019/B	Turbo Soakback	Ashcroft	B424	Dry
IPS-82-5020	Turbo Soakback	Ashcroft	B424	Dry
IPS-82-5021/B	Lo Engine Alarm	Ashcroft	B424	Dry
IPS-82-5022/A	Lo Engine Alarm	Ashcroft	B424	Dry
IPS-82-5023/B	Lo Engine Shutdown	Ashcroft	B424	Dry
IPS-82-5024/A	Lo Engine Shutdown	Ashcroft	B424	Dry
IPS-82-5025	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-5026	Hi Crankcase Alarm	GM	8362040	Dry
IPS-82-5027/A	Lo Alarm	Ashcroft	B424	Dry
IPS-82-5028/B	Lo Alarm	Ashcroft	B424	Dry
IPS-82-5029/B	Lo Engine Idle	Ashcroft	B424	Dry
IPS-82-5030/A	Lo Engine Idle	Ashcroft	B424	Dry
IPS-82-5031	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-5032	Hi Air Intake Alarm	Square D	AMW3	Dry
IPS-82-5033/A	Start Cutoff Backup	Ashcroft	B424	Dry
IPS-82-5034/B	Start Cutoff Backup	Ashcroft	B424	Dry
IPS-82-5039/A	D.G. Turbo Soakback	Ashcroft	B424	Dry
IPS-82-5040/B	D.G. Turbo Soakback	Ashcroft	B424	Dry

TABLE 28

BFN DIESEL GENERATOR BUILDING SWITCHES

Instrument	Application	Make	Model	Contact Type
(Fuel Oil System, Ref. Dwg. 47W610-18-1, Units 1 & 2)				
LS-18-45A, B, C	Storage Tank A	Meletron	2122-6SS10A	Dry
LS-18-46A, B, C	Storage Tank B	Meletron	2122-6SS10A	Dry
LS-18-47A, B, C	Storage Tank C	Meletron	2122-6SS10A	Dry
LS-18-48A	Storage Tank D	Meletron	2122-6SS10A	Dry
LS-18-48B	Storage Tank D	Barksdale	D2T-M18	Dry
LS-18-48C	Storage Tank D	Meletron	2222-17SS9	Dry
LS-18-55A, B, C, D	Day Tank A, B, C, D	Magnetrol	A-103X	Mercury
LS-18-56A, B, C, D	Day Tank A, B, C, D	Magnetrol	A-153-X-TDM	Mercury
LS-18-57A, B, C, D	Day Tank A, B, C, D	Magnetrol	A-153-X-TDM	Mercury
PS-18-52A, B, C, D	Engine A, B, C, D Priming	Square D	ACW-25	Dry
PS-18-54A, B, C, D	Engine A, B, C, D Normal	Square D	ACW-25	Dry
(Fuel Oil System, Ref. Dwg. 47W610-18-2, Unit 3)				
LS-18-61A, B, C	Storage Tank 3A	Meletron	2222-17SS9	Dry
LS-18-62A, B, C	Storage Tank 3B	Meletron	2222-17SS9	Dry
LS-18-63A, B, C	Storage Tank 3C	Meletron	2222-17SS9	Dry
LS-18-64A, B, C	Storage Tank 3D	Meletron	2222-17SS9	Dry
LS-18-70A, B, C, D	3D Day Tank 3A, 3B, 3C	Magnetrol	A-103X	Mercury
LS-18-72A, B, C, D	3D Day Tank 3A, 3B, 3C	Magnetrol	A-153-X-TDM	Mercury
PS-18-67A, B, C, D	Engine 3A, 3B, 3C, 3D Priming	Square D	ACW-25	Dry
PS-18-69A, B, C D	Engine 3A, 3B, 3C, 3D Normal	Square D	ACW-25	Dry
HP Fire Protection System, Ref. Dwg. 47W610-26-11)				
PS-26-80	Preaction Sprinkler	U.E.C.	5355 J7X	Dry
PS-26-81	Preaction Sprinkler	U.E.C.	5355 J7X	Dry
PS-26-82	Fixed Water Spray	U.E.C.	5355 J7X	Dry

TABLE 28 (cont'd)

Instrument	Application	Make	Model	Contact Type
CO_2 Storage, Fire Protection, Ref. Dwg. 47W610-39-1, Units 1 & 2 & 47W610-39-2, Unit 3)				
LS-39-2B, C	CO_2 Storage Unit	Cardox	A-46295 SCR94161-1 (modified)	Mercury
PS-39-3A, B	CO_2 Storage Unit	Allen Bradley	836	Dry
PS-39-3C	CO_2 Storage Unit	Mercoid	DA-61-3	Mercury
PS-39-3D, E	CO_2 Storage Unit	Allen Bradley	836	Dry
PS-39-5	CO_2 DG Electrical Board Room A	Cardox	41644	Dry
PS-39-6	CO_2 DG Electrical Board Room B	Cardox	41644	Dry
PS-39-7	CO_2 Diesel Generator Room A	Cardox	41644	Dry
PS-39-8	CO_2 Diesel Generator Room B	Cardox	41644	D[illegible]
PS-39-9	CO_2 Diesel Generator Room C	Cardox	41644	Dry
PS-39-10	CO_2 Diesel Generator Room D	Cardox	41644	Dry
PS-39-25	CO_2 Fuel Oil Transfer Pump Room	Cardox	41644	Dry
LS-39-33B, C	CO_2 Storage Unit 3	Cardox	A-46187 SCR84699-1 (modified)	Mercury
PS-39-34A, B	CO_2 Storage Unit 3	Allen Bradley	836	Dry
PS-39-36	CO_2 DG Electrical Board Room 3EA	Cardox	41644	Dry
PS-39-37	CO_2 DG Electrical Board Room 3EB	Cardox	41644	Dry
PS-39-38	CO_2 Diesel Generator Room 3A	Cardox	41644	Dry
PS-39-39	CO_2 Diesel Generator Room 3B	Cardox	41644	Dry
PS-39-40	CO_2 Diesel Generator Room 3C	Cardox	41644	Dry
PS-39-41	CO_2 Diesel Generator Room 3D	Cardox	41644	Dry
PS-39-43	CO_2 Fuel Oil Transfer Pump Room 3	Cardox	41644	Dry

TABLE 28 (cont'd)

Instrument	Application	Make	Model	Contact Type
(EECW System Ref. Dwg. 47W610-67-1 & 2)				
PS-67-54A	EECW North Header Units 1 & 2	Meletron	2121-32A	Dry
PS-67-54B	EECW North Header Unit 3	Meletron	2221-25	Dry
PS-67-55A	EECW South Header Units 1 & 2	Meletron	2121-32A	Dry
PS-67-55B	EECW South Header Unit 3	Meletron	2221-25	Dry

The following switches in the diesel generator starting air and lube oil systems were verified by physical walkdown to identify application, make, and model.

Instrument	Application	Make	Model	Contact Type
(Units 1 and 2)				
PS-86-30A, B, C, D	Air Header Left Bank	Square D	ACW-8	Dry
PS-86-32A, B, C, D	Air Header Right Bank	Square D	ACW-8	Dry
(Unit 3)				
PS-82-22A, B, C D	Air Header Left Bank	Square D	ACW-8	Dry
PS-82-24A, B, C D	Air Header Right Bank	Square D	ACW-8	Dry
(Units 1 and 2)				
PS-82-25A, B, C, D	Lube Oil System	Micro Switch	M8805/1-012	Dry
PS-82-27A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
PS-82-28A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
PS-82-29A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
Vendor ID (LS) LOL	Lube Oil System	GM	Part #8445672	Dry

TABLE 28 (cont'd)

Instrument	Application	Make	Model	Contact Type
(EECW System Ref. Dwg. 47W610-67-1 & 2) (continued) (Unit 3)				
Vendor ID (PS) CPS	Lube Oil System	Micro Switch	M8805/1-012	Dry
PS-82-12A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
PS-82-13A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
PS-82-14A, B, C, D	Lube Oil System	Square D	ACW-25	Dry
Vendor ID (LS) LOL	Lube Oil System	GM	Part #8445672	Dry

TABLE 29

BLN DIESEL GENERATOR BUILDING - PROCESS SENSING SWITCHES

Instrument	Application	Make	Model	Contact Type
Fuel Oil System - System FF (typical for units 1 and 2):				
ILS-017A-B	Day Tank MTNK-017-B	Magnetrol	B10-1H2A	Dry+
ILS-017B-B	Day Tank MTNK-017-B	Magnetrol	B10-1H2A	Dry+
ILS-017-B	Day Tank MTNK-017-B	Magnetrol	B15-1H2C	Dry+
ILS-018B	Drip Tank MTNK-018-B	Magnetrol	A103F-SIM3	Dry+
ILS-019A-A	Day Tank MTNK-019-A	Magnetrol	B10-1H2A	Dry+
ILS-019B-A	Day Tank MTNK-019-A	Magnetrol	B10-1H2A	Dry+
ILS-019-A	Day Tank MTNK-019-A	Magnetrol	B15-1H2C	Dry+
ILS-020A	Drip Tank MTNK-020-A	Magnetrol	A103F-SIM3	Dry+
IDS-035A	Eng Fuel PP Strainer	Barksdale	DPDIT-M-80	Dry
IDS-036B	Eng Fuel PP Strainer	Barksdale	DPDIT-M-80	Dry
IDS-037B	DC Fuel PP Strainer	Barksdale	DPDIT-M-90	Dry
IDS-038A	DC Fuel PP Strainer	Barksdale	DPDIT-M-90	Dry
FDS-118C-A	Fuel Oil Filter	Barksdale	DPDIT-M-80	Dry
FDS-218C-B	Fuel Oil Filter	Barksdale	DPDIT-M-80	Dry

+Indicates switch not installed in unit 2.

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
Starting Air System - System RG (typical for units 1 and 2):				
IPS-001-A	Air Receiver MRCR 001A	Square D	ASG-11	Dry
IPS-002-A	Air Receiver MRCR 002A	Square D	ASG-11	Dry
IPS-003-B	Air Receiver MRCR 003B	Square D	ASG-11	Dry
IPS-004-B	Air Receiver MRCR 004B	Square D	ASG-11	Dry
FPS-033A-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-033B-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-034A-B	Starting Air System	Barksdale/Micro Switch		Dry
FPS-034B-B	Starting Air System	Barksdale/Micro Switch		Dry
FPS-035A-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-035B-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-036A-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-036B-A	Starting Air System	Barksdale/Micro Switch		Dry
FPS-037A-B	Starting Air System	Barksdale/Micro Switch		Dry
FPS-037B-B	Starting Air System	Barksdale/Micro Switch		Dry
FPS-038A-B	Starting Air System	Barksdale/Micro Switch		Dry
FPS-038B-B	Starting Air System	Barksdale/Micro Switch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
Standby Diesel Generator and Controls - System RT (typical for units 1 and 2):				
FPS-212-A *PS-8C	Lube Oil Pump-A start	Barksdale	E1H Series	Dry
FPS-212B-B *PS-8C	Lube Oil Pump-B start	Barksdale	E1H Series	Dry
FPS-213-A *PS-8D	Lube Oil Pump-A stop	Barksdale	E1H Series	Dry+
FPS-213B-B *PS-8D	Lube Oil Pump-B stop	Barksdale	E1H Series	Dry+
FPS-214-A *PS-9A	Exciter Reg Lockout	Barksdale/Microswitch		Dry
FPS-215-B *PS-9A	Exciter Reg Lockout	Barksdale/Microswitch		Dry
FPS-216-A *PS-9B	Generator Bkr Trip	Barksdale/Microswitch		Dry
FPS-217-B *PS-9B	Generator Bkr Trip	Barksdale/Microswitch		Dry
FPS-218-A *PS-9C	Unit A Tripped	Barksdale/Microswitch		Dry
FPS-219-B *PS-9C	Unit B Tripped	Barksdale/Microswitch		Dry
FPS-220-A *PS-9D	Unit A Tripped	Barksdale/Microswitch		Dry
FPS-221-B *PS-9D	Unit B Tripped	Barksdale/Microswitch		Dry

*Indicates vendor cross-reference number
+Indicates switch not installed in unit 2

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-222-A *PS-10A	Governor Droop	Barksdale/Microswitch		Dry
FPS-223-B *PS-10A	Governor Droop	Barksdale/Microswitch		Dry
FPS-224-A *PS-10B	Governor Droop	Barksdale/Microswitch		Dry
FPS-225-B *PS-10B	Governor Droop	Barksdale/Microswitch		Dry
FPS-226-A *PS-10C	Emergency start	Barksdale/Microswitch		Dry
FPS-227-B *PS-10C	Emergency start	Barksdale/Microswitch		Dry
FPS-228-A *PS-10D	Engine Stop	Barksdale/Microswitch		Dry
FPS-229-B *PS-10D	Engine Stop	Barksdale/Microswitch		Dry
FPS-230-A *PS-10E	Emergency start	Barksdale/Microswitch		Dry
FPS-231-B *PS-10E	Emergency start	Barksdale/Microswitch		Dry
FPS-232-A *PS-10F	Shutdown syst active	Barksdale/Microswitch		Dry
FPS-233-B *PS-10F	Shutdown syst active	Barksdale/Microswitch		Dry
FPS-234-A *PS-12A	Manual start	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-235-B *PS-12A	Manual start	Barksdale/Microswitch		Dry
FPS-236-A *PS-12B	Manual start	Barksdale/Microswitch		Dry
FPS-237-B *PS-12B	Manual start	Barksdale/Microswitch		Dry
FPS-238-A *PS-13C	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-239-B *PS-13C	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-240-A *PS-13D	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-241-B *PS-13D	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-242-A *PS-13E	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-243-B *PS-13E	Barring Device Lockout	Barksdale/Microswitch		Dry
FPS-244-A *PS-14C	Jacket Water Temperature	Barksdale/Microswitch		Dry
FPS-245-B *PS-14C	Jacket Water Temperature	Barksdale/Microswitch		Dry
FPS-246-A *PS-15C	Bearing Temperature	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-247-B *PS-15C	Bearing Temperature	Barksdale/Microswitch		Dry
FPS-248-A *PS-16C	Lube Oil Temperature	Barksdale/Microswitch		Dry
FPS-249-B *PS-16C	Lube Oil Temperature	Barksdale/Microswitch		Dry
FPS-250-A *PS-17C	Lube Oil Filter	Barksdale/DPDIT-M80		Dry
FPS-251-B *PS-17C	Lube Oil Filter	Barksdale/DPDIT-M80		Dry
FPS-252-A *PS-19C	Turbo Oil	Barksdale/Microswitch		Dry
FPS-253-B *PS-19C	Turbo Oil	Barksdale/Microswitch		Dry
FPS-254-A *PS-20C	Turbo Oil Left Bank	Barksdale/Microswitch		Dry
FPS-255-B *PS-20C	Turbo Oil Left Bank	Barksdale/Microswitch		Dry
FPS-256-A *PS-21C	Jacket Water	Barksdale/Microswitch		Dry
FPS-257-B *PS-21C	Jacket Water	Barksdale/Microswitch		Dry
FPS-258-A *PS-22C	Jacket Water	Barksdale/Microswitch		Dry
FPS-259-B *PS-22C	Jacket Water	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-260-A *PS-23C	Lockout with Delay	Barksdale/Microswitch		Dry
FPS-261-B *PS-23C	Lockout with Delay	Barksdale/Microswitch		Dry
FPS-263-B *PS-25C	Lube Oil	Barksdale/Microswitch		Dry
FPS-264-A *PS-25C	Lube Oil	Barksdale/Microswitch		Dry
FPS-265-B *PS-26C	Vibration Trip	Barksdale/Microswitch		Dry
FPS-266-A *PS-26C	Vibration Trip	Barksdale/Microswitch		Dry
FPS-267-B *PS-27C	Crankcase	Barksdale/Microswitch		Dry
FPS-268-A *PS-27C	Crankcase	Barksdale/Microswitch		Dry
FPS-269-B *PS-29C	Overspeed Trip	Barksdale/Microswitch		Dry
FPS-270-A *PS-29C	Overspeed Trip	Barksdale/Microswitch		Dry
FPS-271-B *PS-29C	Overspeed Trip	Barksdale/Microswitch		Dry
FPS-272-A *PS-29D	Overspeed Trip	Barksdale/Microswitch		Dry
FPS-273-B *PS-30A	Field Flash	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-274-A *PS-30A	Field Flash	Barksdale/Microswitch		Dry
FPS-275-B *PS-30B	Field Flash	Barksdale/Microswitch		Dry
FPS-276-A *PS-30B	Field Flash	Barksdale/Microswitch		Dry
FPS-277-B *PS-31A	DC Power Avail. (Spare)	Barksdale/Microswitch		Dry
FPS-278-A *PS-31A	DC Power Avail. (Spare)	Barksdale/Microswitch		Dry
FPS-280-A *PS-31B	DC Power Avail. (Spare)	Barksdale/Microswitch		Dry
FPS-281-B *PS-31B	DC Power Avail. (Spare)	Barksdale/Microswitch		Dry
FPS-282-A *PS-31C	DC Power Available	Barksdale/Microswitch		Dry
FPS-283-B *PS-31C	DC Power Available	Barksdale/Microswitch		Dry
FPS-284-A *PS-31D	DC Power Available	Barksdale/Microswitch		Dry
FPS-285-B *PS-31D	DC Power Available	Barksdale/Microswitch		Dry
FPS-286-A *PS-32A	Exciter Regulation	Barksdale/Microswitch		Dry
FPS-287-B *PS-32A	Exciter Regulation	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-288-A *PS-32B	Exciter Reg. Enable	Barksdale/Microswitch		Dry
FPS-289-B *PS-32B	Exciter Reg. Enable	Barksdale/Microswitch		Dry
FPS-290-A *PS-32BB	Fuel Oil Booster Pump	Barksdale/Microswitch		Dry
FPS-291-B *PS-32BB	Fuel Oil Booster Pump	Barksdale/Microswitch		Dry
FPS-292-A *PS-32C	Diesel Starting	Barksdale/Microswitch		Dry
FPS-293-B *PS-32C	Diesel Starting	Barksdale/Microswitch		Dry
FPS-294-A *PS-32E	Diesel Starting	Barksdale/Microswitch		Dry
FPS-295-B *PS-32E	Diesel Starting	Barksdale/Microswitch		Dry
FPS-296-A *PS-33A	Synchronous speed	Barksdale/Microswitch		Dry
FPS-297-B *PS-33A	Synchronous speed	Barksdale/Microswitch		Dry
FPS-298-A *PS-33B	Synchronous speed	Barksdale/Microswitch		Dry
FPS-299-B *PS-33B	Synchronous speed	Barksdale/Microswitch		Dry
FPS-300-A *PS-33C	Synchronous speed	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-301-B *PS-33C	Synchronous speed	Barksdale/Microswitch		Dry
FPS-302-A *PS-33D	Synchronous speed	Barksdale/Microswitch		Dry
FPS-303-B *PS-33D	Synchronous speed	Barksdale/Microswitch		Dry
FPS-304-A *PS-33E	Synchronous speed	Barksdale/Microswitch		Dry
FPS-305-B *PS-33E	Synchronous speed	Barksdale/Microswitch		Dry
FPS-306-A *PS-33BB	Synchronous speed	Barksdale/Microswitch		Dry
FPS-307-B *PS-33BB	Synchronous speed	Barksdale/Microswitch		Dry
FPS-308-A *PS-34C	Ready to Load	Barksdale/Microswitch		Dry
FPS-309-B *PS-34C	Ready to Load	Barksdale/Microswitch		Dry
FPS-310-A *PS-39C	Control Air	Barksdale/Microswitch		Dry
FPS-311-B *PS-39C	Control Air	Barksdale/Microswitch		Dry
FPS-312-A *PS-40A	Operation/Maintenance	Barksdale/Microswitch		Dry
FPS-313-B *PS-40A	Operation/Maintenance	Barksdale/Microswitch		Dry

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
FPS-314-A *PS-40B	Operation/Maintenance	Barksdale/Microswitch		Dry
FPS-315-B *PS-40B	Operation/Maintenance	Barksdale/Microswitch		Dry
FPS-318-A *PS-42C	Lube Oil Trip	Barksdale/Microswitch		Dry
FPS-319-B *PS-42C	Lube Oil Trip	Barksdale/Microswitch		Dry
FPS-320-A *PS-43C	Turbo Oil	Barksdale/Microswitch		Dry
FPS-321-B *PS-43C	Turbo Oil	Barksdale/Microswitch		Dry
FPS-322-A *PS-44C	Generator Differential	Barksdale/Microswitch		Dry
FPS-323-B *PS-44C	Generator Differential	Barksdale/Microswitch		Dry
FPS-324-A *PS-37C	Jacket Water Level	Dwyer	1823	Dry+
FPS-325-B *PS-37C	Jacket Water Level	Dwyer	1823	Dry+
FDPS-649-A	Lube Oil Strainer	Barksdale	DPDIT-M80	Dry
FDPS-650-B	Lube Oil Strainer	Barksdale	DPDIT-M80	Dry
FLS-655-A	Lube Oil Level	Magnetrol	A-153F-K-SIM-3	Dry
FLS-656-B	Lube Oil Level	Magnetrol	A-153F-K-SIM-3	Dry

+Indicates switch not installed in unit 2

TABLE 29 (CONT'D)

Instrument	Application	Make	Model	Contact Type
CO_2 Storage, Fire Protection and Purge System - System GC (typical for units 1 and 2):				
ILIS-001-N	CO_2 Unit	Cardox	A-46295 SCR94161	Dry
IPS-001-N	CO_2 Storage Tank	Allen-Bradley	836P17	Dry
IPS-001G-N	CO_2 Refrigerant High	Allen-Bradley	836	Dry
IPS-001H-N	CO_2 Control	Mercoid	DS7241-153	Dry
IPS-001I-N	CO_2 Refrigerant Low	Allen-Bradley	836AL32	Dry
IPS-011-N	CO_2 Oil Transfer Pump Room	ASCO	SB11AK	Dry
IPS-012-N	CO_2 Diesel Generator Room A	ASCO	SB11AK	Dry
IPS-013-N	CO_2 Diesel Generator Room B	ASCO	SB11AK	Dry
IPS-014-N	CO_2 Elect. Board Room A	ASCO	SB11AK	Dry
IPS-015-N	CO_2 Elect. Board Room B	ASCO	SB11AK	Dry
High-pressure Fire Protection System - System RF (typical for units 1 and 2):				
IPS-D09	Sprinkler Preaction Valve	ASCO	SB11AK	Dry
IPS-D09A	Sprinkler Preaction Monitor	ASCO	SB21AK	Dry
IPS-D10	Sprinkler Preaction Valve	ASCO	SB11AK	Dry
IPS-D10A	Sprinkler Preaction Monitor	ASCO	SB21AK	Dry

TABLE 30
SQN AND WBN RADIATION MONITORING SYSTEMS

Stream/System/Area Monitored	Monitors/ Plant FSAR	Monitors/ Plant SER	Detector Type	Detectors/ Monitor	Remarks
Liquid Effluent Monitors					
Waste Disposal System	1	1	-Scint.	1	Same as SQN.
Essential Raw Cooling	4	4	-Scint.	2	Same as SQN.
Component Cooling Water	3	3	-Scint.	1	Same as SQN.
Steam Generator Blowdown-Individual Sample Lines (Process)	2	4	-Scint	1	Same as SQN. SER "monitors/plant" is in error.
Steam Generator Blowdown-Common Header	2	2	-Scint.	2	Same as SQN.
Condensate Demineralizer Regenerant Effluent	1	-	-Scint.	1	Not noted by WBN SER. Not provided for SQN.
Boric Acid Evaporator Condensate	2	-	-Scint.	1	Same as SQN. Not noted by WBN SER.
Reactor Coolant Letdown	2	-	-Scint.	1	Same as SQN. Not noted by WBN SER.

TABLE 30
SQN AND WBN RADIATION MONITORING SYSTEMS

Stream/System/Area Monitored	Monitors/ Plant FSAR	Monitors/ Plant SER	Detector Type	Detectors/ Monitor	Remarks
Liquid Effluent Monitors (cont'd)					
Plant Liquid Discharge	1	-	-Scint.	1	Not noted by WBN SER. Added to SQN subsequent to FSAR & SER (DC-V-9.0, R2).
Turbine Building Sump Effluent	1	-	-Scint.	1	Not noted by WBN SER. Added to SQN subsequent to FSAR & SER (DC-V-9.0, R2).
Gaseous Effluent Monitors					
Waste Gas Holdup System Effluent	1	1	-Scint.	1	Same as SQN.
Condenser Vacuum Exhaust - Normal Range	2	2	-Scint.	1	Same as SQN.
Condenser Vacuum Exhaust - High Range	2	2	-Scint.	1	Same as SQN.
Condenser Vacuum Exhaust - Post Accident	2	-	GM Tube	2	Not noted by WBN SER. Added to SQN subsequent to FSAR & SER (DC-V-9.0, R2).
Fuel Pool Radiation	2	-	GM Tube	1	Same as SQN. Not noted by WBN SER.
Containment Building - Lower Compartment - Normal Range	2	-	-Scint. -Scint. -Scint./ GM Tube	3	Same as SQN. Not noted by WBN SER.

TABLE 30
SQN AND WBN RADIATION MONITORING SYSTEMS

Stream/System/Area Monitored	Monitors/Plant FSAR	Monitors/Plant SER	Detector Type	Detectors/Monitor	Remarks
Gaseous Effluent Monitors (cont'd)					
Containment Building - Upper Compartment - Normal Range	2	-	-Scint. -Scint. -Scint./ GM Tube	3	Same as SQN. Not noted by WBN SER.
Containment Building - Lower Compartment - Accident Range	-	-	Ion chamber	-	Four monitors/plant added by WB-DC-30-7, R1.
Upper Compartment - Accident Range	-	-	Ion chamber	-	Four monitors/plant added by WB-DC-30-7, R1.
Shield Building Exhaust - Normal Range	2	2	-Scint. GM Tube	2	Same as SQN except 3 detectors/ monitor are provided (DC-V-9.0, R2). SER does not note GM tube.
Shield Building Exhaust - Accident Range	2	-	GM Tube	2	Not noted by WBN SER. Added to SQN subsequent to FSAR & SER (DC-V-9.0, R2).
Auxiliary Building Exhaust	1	1	-Scint. -Scint. -Scint./ GM Tube	3	Same as SQN.
Service Building Exhaust	1	-	-Scint. -Scint. -Scint./ GM Tube	3	Same as SQN. Not noted by WBN SER.

Stream/System/Area Monitored	Monitors/ Plant FSAR	Monitors/ Plant SER	Detector Type	Detectors/ Monitor	Remarks
Gaseous Effluent Monitors (cont'd)					
Main Control Room Air Intake, Normal & Emergency Path	4	-	-Scint.	1	Not noted by WBN SER. SQN FSAR states "2 monitors/ plant." Revised by DC-V-9.0, R2 to "4 monitors/plant."
Containment Purge Air Exhaust	4	4	-Scint.	1	Same as SQN.
Main Steamline Radiation, Low and High Range	8	-	GM Tube	2	Not provided for SQN. Not noted by WBN SER. Satisfies RG 1.97, Rev. 2.
Area Radiation Monitors					
Auxiliary Building Areas					Same as SQN
Spent Fuel Pool	2	2	GM Tube	1	
Waste Packaging	1	1	GM Tube	1	
Equipment Decon.	1	1	GM Tube	1	
Fuel Pool Pump	1	1	GM Tube	1	
Comp. Cooling Ht. Exch.	2	2	GM Tube	1	
Sample Room	2	2	GM Tube	1	
Aux. FW Pumps	2	2	GM Tube	1	
Waste Evap. Tank	1	1	GM Tube	1	
React. MOV Bd.	2	2	GM Tube	1	
RHR Pump	1	1	GM Tube	1	
Personnel Lock	2	2	GM Tube	1	
Reactor Building Areas					
Refueling Floor	4	4	GM Tube	1	Not provided for SQN, but SQN provides monitors at reactor building access hatch and personnel lock for each unit.

TABLE 30
SQN AND WBN RADIATION MONITORING SYSTEMS

Stream/System/Area Monitored	Monitors/Plant FSAR	Monitors/Plant SER	Detector Type	Detectors/Monitor	Remarks
Area Radiation Monitors					
Instrument Room	2	2	GM Tube	1	Same as SQN
Main Control Room	1	1	GM Tube	1	Same as SQN
Airborne Particulate Monitors					
Auxiliary Building Areas					
Spent Fuel Pool	1	1	-Scint.	1	Not provided for SQN.
Sample Rooms	2	2	-Scint.	1	Added to SQN subsequent to FSAR & SER (DC-V-9.0, R2).
Decontamination	1	1	-Scint.	1	Not provided for SQN.
Waste Packaging	2	2	-Scint.	1	Not provided for SQN.
General Spaces	2	2	-Scint.	1	Not provided for SQN.
Main Control Room	1	1	-Scint.	1	Added to SQN subsequent to FSAR and SER (DC-V-9.0, R2).
Primary Containment, Normal Range	2	2	-Scint.	1	Not provided for SQN.

TABLE 31
SQN RMS MONITORS NOT INCLUDED IN WBN RMS

Stream/System/Area Monitored	Monitors/ Plant	Detector Type	Detectors/ Monitor	Basis for Inclusion as given by SQN-DC-V-9.0, R2
Reactor Coolant Drain Tank Discharge	4	GM Tube	1	To satisfy requirements for Section IV.A from "TVA Nuclear Program Review, Task Force on Nuclear Safety," May 1979 (Ref. 166) resulting from TMI lessons learned.
Containment Building Floor and Equipment Drain Sump Discharge	4	GM Tube	1	Same as above.
Residual Heat Removal Lines	4	GM Tube Ion Chamber	2	Same as above.
Outside Containment Personnel Hatch	2	GM Tube	1	Provided as part of early plant design. No longer required due to additional containment monitors provided, but will be retained for the present.

TABLE 32

BLN RADIATION MONITORING SYSTEM

Stream/System/Area Monitored	Monitors/ Unit or Common	Remarks
PROCESS AND EFFLUENT RADIOACTIVITY MONITORING AND SAMPLING SYSTEMS (PERMSS)		
1. Gaseous Effluent Monitors		
Station vent - low range	2/unit	Two on unit 1 installed
Station vent - high range	1/unit	None installed
Containment purge exhaust	2/unit	Two on unit 1 installed
Turbine Building vent	1/common	Not installed
Condenser vacuum pump exhaust-low range	1/unit	None installed
Condenser vacuum pump exhaust-high range	1/unit	None installed
Waste disposal system gas decay tanks	1/common	Installed
		Total gaseous effluent monitors - 16
2. Liquid Effluent Monitors		
Plant liquid effluent	1/common	Not installed
Waste disposal system	1/common	Installed
Turbine Building sump/discharge	1/common	Not installed
Waste disposal lines	7/common	None installed

Stream/System/Area Monitored	Monitors/ Unit or Common	Remarks
Auxiliary boiler blowdown sump discharge	1/common	Not installed
Hot shop facility discharge	1/common	Not installed
		Total liquid effluent monitors - 12
3. Liquid Process Monitors		
Component cooling water	2/unit	Installed
Essential raw cooling	2/common	Installed
Reactor coolant letdown	1/unit	Installed
Boric acid evaporator/distillate	2/common	Installed
Condensate demineralizer	2/common	None installed
		Total liquid process monitors - 12

AREA AND AIRBORNE RADIOACTIVITY RADIATION MONITORING SYSTEMS(ARMS)

1. Area Radiation Monitors		
A. Auxiliary Building Areas		
Spent fuel pool	1/unit	Installed
Waste packaging	1/common	Installed
Equipment decon.	1/common	Installed
Common area	2/common	Installed
Outside spent resin tank room	1/common	Installed

TABLE 32

BLN RADIATION MONITORING SYSTEM

Stream/System/Area Monitored	Monitors/ Unit or Common	Remarks
Surge tank area	1/common	Installed
Hot sampling room	1/unit	Installed
Near stairs and hatch	1/common	Installed
Reactor coolant drain tank sump	2/unit	Two on unit 1 installed
Reactor Building sumps	2/unit	Installed
Near RC bleed evap. demin.	1/common	Installed
Process tanks - various	10/unit	Nine on unit 1, seven on unit 2 installed
DHR piping	2/unit	One on unit 1 installed
Post-accident sampling facility	2/common	None installed
B. Containment Areas		
Refueling canal ventilation	2/unit	Two on unit 1 installed
Incore instrument tank	1/unit	One on unit 1 installed
Near elevator	2/unit	One on unit 1 installed
Fuel pool	1/unit	None installed
R. B. instrument room	1/unit	One on unit 1 installed
Near personnel hatch	1/unit	None installed

TABLE 32

BLN RADIATION MONITORING SYSTEM

Stream/System/Area Monitored	Monitors/ Unit or Common	Remarks
C. Control Building		
Main control room	2/common	Installed
C. Post-Accident Monitors		
Containment high range	2/unit	Installed
Main steam line	4/unit	None installed
		Total Area Radiation Monitors = 76
2. Airborne Radioactivity Monitors		
Primary containment	2/unit	Two on unit 1 installed
Reactor Building instrument room	1/unit	None installed
Post-accident sampling facility	1/common	Not installed
Spent fuel storage	1/unit	Installed
Auxiliary Building, trained area	2/unit	None installed
Auxiliary Building, common area	3/common	None installed
Condensate vacuum pump	1/unit	Collection only. Not Installed
Main control room	2/common	Installed
Main control room inlet air	4/common	Two monitors provide MCR habitability control - none installed

TABLE 32

BLN RADIATION MONITORING SYSTEM

Stream/System/Area Monitored	Monitors/ Unit or Common	Remarks
Portable monitors	4/common	Grab sampling function - none
		Total airborne radioactivity monitors: 28
Personnel Protection Monitors		
Auxiliary Building area friskers	8/unit 1 & 7/unit 2	
Auxiliary Building area friskers	10/common	
		Total friskers - 25
Auxiliary Building area hand & foot counter	2/common	
Auxiliary Building area hand and foot counter	1/unit	
Diesel Generator Building area hand and foot counter	2/common	
		Total hand and foot counters - 6
Diesel Generator Building area portal monitor	4/common	
		Total portal monitors - 4

TABLE 33
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 22900

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS: 1 Frag-mented Organ-iza-tion	2 Inade-quate Q-trng	3 Inade-quate Proce-dures	4 Proce-dures Not Fol-lowed	5 Inade-quate Com-muni-cation	6 Un-timely Res of Issues	7 Lack of Mgt Atten	DESIGN PROCESS EFFECTIVENESS: 8 Inade-quate Design Bases	9 Inade-quate Calcs	10 Inade-quate As-blt Recon-cil.	11 Lack of Design Detail	12 Engrg Judgmt not Docu-mented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Docu-menta-tion	TECHNICAL ADEQUACY: 15 Stds Not Fol-lowed	16 Engrg Error	17 Vendor Error	Signifi-cance of Corrective Actions* D	M	H
229.1	D5, C5	Perform loop accuracy calculations and compare results to defined safety limits.	BFN 01 SQN 01 WBN 01 (BLN)									X				X					A	P	P
229.2	D1	Review as-built panel drawings and modify potentially radioactive panel drains as appropriate.	BFN 01													X					-	-	-
229.3	C1	Complete wiring change associated with replacement of flow transmitter FE-27-98.	WBN 01																X		-	-	-
229.5	E1	Modify auxiliary control air (ACA) subsystem to prevent total loss of ACA function in the event of a high energy pipe break and a single failure in the ACA system.	SQN 01																X		A	-	A
229.9	E3	Revise FSAR to reflect additional information concerning the loose parts monitoring system (LPMS).	WBN 01										X								-	-	-
229.10	D6	Document justification for "use as is" or replace mercury switches in diesel generator support systems with switches containing no free mercury.	BFN 01													X					-	-	-
229.11	E3	Revise FSAR to reflect addition of postaccident monitoring (PAM) equipment to plant.	SQN 01								X		X								-	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

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TABLE 33
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 22900

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS: 1 Frag-mented Organ-iza-tion	2 Inade-quate Q-trng	3 Inade-quate Proce-dures	4 Proce-dures Not Fol-lowed	5 Inade-quate Com-muni-cation	6 Un-timely Res of Issues	7 Lack of Mgt Atten	DESIGN PROCESS EFFECTIVENESS: 8 Inade-quate Design Bases	9 Inade-quate Calcs	10 Inade-quate As-blt Recon-cil.	11 Lack of Design Detail	12 Engrg Judgmt not Docu-mented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Docu-menta-tion	TECHNICAL ADEQUACY: 15 Stds Not Fol-lowed	16 Engrg Error	17 Vendor Error	Signifi-cance of Corrective Actions* D	M	H
	E3	Revise RMS design documents and FSAR to eliminate inconsistencies.	SQN 02																				
			WBN 01																				
			BLN 01								X		X								-	-	-
			BLN 02																				
			BLN 03																				
	C1	Complete installation and checkout of postaccident monitoring (PAM) equipment.	BFN 01							X	X									X	A	-	A
	E7	Track open licensing issue on RG 1.97 until resolved with NRC.	BFN 02						X												-	-	-
			TOTALS						1	1	3	1	3			3			2	1			

* Defined in the Glossary Supplement.

** Defined in Table 1.