TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM

REPORT NUMBER: 90700

REPORT TYPE: Watts Bar Nuclear Plant Subcategory

REVISION NUMBER: 2

TITLE: Design as Related to Industrial Safety

PAGE 1 OF 45

REASON FOR REVISION:

Incorporate editorial changes, and a revision of section 7.0.

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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 (terms formed from the first letters of a series of words).

Additionally, at the end of each subcategory report the reader will find at least two attachments. The first is a Subcategory Summary Table that includes the following information: the concern number, a brief statement of the concern, and a designation of nuclear safety-related concerns. The second attachment is a listing of the concerns included in each issue evaluated in the subcategory.

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

1.0 CHARACTERIZATION OF ISSUES

This report covers issues relating to unsafe or perceived unsafe working conditions at the Tennessee Valley Authority's (TVA) Watts Bar Nuclear (WBN), Browns Ferry Nuclear (BFN), and Sequoyah Nuclear (SQN) Plants. This report covers only situations or conditions resulting from the design process.

The Design Subcategory is one part of the Industrial Safety Category of TVA's Employee Concerns Special Program (ECSP). It is composed of 23 individual employee concerns, listed in Attachment A, which involve the following three basic issues:

a. Access and egress hazards due to cramped and crowded conditions that result from the basic design of the plants.

b. Personnel work stations which are located near steam lines and similar hazards.

c. The safety of carbon dioxide (CO_2) fire protection systems.

The Design Subcategory contains no nuclear safety-related concerns.

1.1 Access Issues

Eight of the concerns, IN-85-098-001, IN-85-189-003, IN-85-463-002, IN-85-746-001, IN-85-841-002, IN-85-861-002, IN-85-906-001, and XX-85-106-001, involve access issues at BFN and WBN. These issues were evaluated as three subdivisions which were established by grouping similar concerns together.

1.1.1 Personnel Access Issues

This group of concerns consists of six of the eight accessibility concerns. These concerns are specific to WBN.

Two concerns are about the number and size of pipe hangers and support bracing in several plant areas. IN-85-841-002 alleges that excessive and unnecessary pipe hangers create unsafe access conditions. IN-85-746-001 alleges that excessive support bracing installed in the plant creates a personnel safety hazard. It also indicates that several valves and gauges cannot be reached for operational purposes, and that emergency medical rescue teams will have difficulty evacuating injured personnel from these areas.

Two other concerns, IN-85-861-002 and IN-85-906-001, state that the safety of maintenance personnel entering the accumulator rooms is compromised by the cramped and crowded conditions that exist there.

Concern IN-85-189-003 alleges that there is an inadequate number of permanent ladders within the annulus.

Finally, concern IN-85-098-001 alleges that the design process did not adequately consider plant operation and maintenance since access is difficult and potentially hazardous in areas such as the annulus and accumulator rooms.

1.1.2 Purge Air Valve Issues

This subgroup consists of one WBN concern, IN-85-463-002, relating to a specific valve (TVA identifier 2-FCV-30-54). The concern states that this valve (a "purge air valve") is installed in a congested area, that it blocks a personnel walkway, and that it is hazardous in operation since its actuator mechanism swings when it operates.

1.1.3 Browns Ferry Main Steam Relief Valve Issues

This subgroup is comprised of a single concern (XX-85-106-001) about the work process used to remove and reinstall the main steam relief valves at BFN.

The principal issues are that the method used for removing and reinstalling these valves is unsafe, that at least one minor injury has occurred and that a serious accident is very likely. The individual also states that TVA management has been made aware of this situation on numerous occasions.

1.2 Steam Line Issues

Seven of the concerns in this concern group are about the location of personnel work stations near the main steam lines or turbine lubricating oil tanks. These include, I-85-431-SQN, IN-85-133-001, IN-85-191-003, IN-85-267-001, IN-86-101-002, In-86-137-001, and XX-85-106-001, and involve both SQN and WBN.

The issue involved is that if a steam line catastrophically ruptures near an occupied area, loss of life will occur and security will be lost. A secondary issue arises from a single employee concern about the location of the main turbine oil tanks. This issue states that if an accident occurs involving the main turbine oil tank, many people will be trapped and loss of life may occur since doors to the Control Building are close by.

1.3 Carbon Dioxide Fire Protection Issues

The remaining eight employee concerns in this subcategory relate to the use of carbon dioxide (CO_2) fire protection systems. These involve SQN and WBN only, although CO_2 fire protection systems are used at all of TVA's nuclear plants. This concern group consists of EAC-85-003, EX-85-022-001, IN-85-892-001, IN-85-918-003, IN-85-048-001, RMM-85-004, WBN-241, and WBN-0299.

There are two basic issues within this concern group. The "hardware" issue involves the several suspected or actual deficiencies associated with the CO_2 fire protection system at WBN. The second issue is the "anxiety" issue. This is perhaps the principal issue of the group and is about the threat of asphyxiation that CO_2 fire protection systems pose to plant employees. The anxiety issue arises from concerns at both SQN and WBN.

The eight concerns within this concern group are summarized below into two groups: those that have the "hardware" issue involved, and those that have only an "anxiety" aspect.

1.3.1 "Hardware" Issue

Five concerns have hardware aspects. EX-85-022-001 alleges that there are an insufficient number of breathing devices provided on the level below the WBN 708 Control Building computer rooms, (level 669 at SQN). IN-85-048-001 states that there is no method to detect a CO_2 discharge if the monitors/alarms in the central alarm station (CAS) fail. IN-85-892-003 expresses concern over the removal of the wintergreen odor from the CO_2 fire protection system in the WBN Control Building. IN-85-918-001 alleges that there are several deficiencies associated with the CO_2 fire protection system in WBN Diesel Generator Building #1 such as warning lights that are not visible and alarms that cannot be heard over the operation of the diesel generators. And concern WBN-0299 states that personnel working downstairs in the Diesel Generator Building cannot hear the CO_2 alarm for the upstairs board rooms.

1.3.2 "Anxiety" Issue

Three concerns deal with only the anxiety aspect. EAC-85-003 states that the CO_2 fire protection system in the SQN 669 elevation computer and auxiliary instrument rooms (708 elevation at WBN) endangers employees. RMN-85-004 asks what the CO_2 horn sounds like. And WBN-241 questions the "policy" that maintenance work can be done in the Diesel Generator Building with the CO_2 fire protection system in "automatic."

2.0 SUMMARY

The Design Subcategory is comprised of 23 individual employee concerns involving conditions at BFN, SQN, and WBN. These concerns are about conditions or circumstances that relate to the design process, and fall into three basis areas: (a) accessibility to equipment in cramped and crowded areas, (b) steam lines near personnel locations, and (c) carbon dioxide fire protection systems.

2.1 Summary of Issues

The accessibility issue consists of three "subissues." The principal issue is that access to equipment in certain plant areas is perceived as being difficult and potentially hazardous.

The second issue involves the location of a purge air valve in the annulus and the perception that its operation presents a personnel hazard. The third issue involves the perception that the method used for removing the main steam relief valves from the drywell area at BFN is hazardous.

The steam line issues question the safety of employees who work near main steam lines. The principal issue is that should a steam line catastrophically rupture, significant damage and loss of life would occur. An additional issue involves the perceived danger to employees presented by the turbine lubricating oil tanks in the Turbine Building.

The carbon dioxide fire protection issue consists of concerns that related to specific deficiencies in the CO_2 fire protection system at WBN and to its use in general at both WBN and SQN.

2.2 Summary of the Evaluation Process

The issues contained within this subcategory were evaluated by considering groups of similar concerns. In general the evaluation consisted of the following steps:

a. the collection of all appropriate background material, previous investigations, etc.,

b. the review of design documents, industry codes and standards, Occupational Safety and Health Administration (OSHA) requirements, etc.,

c. the inspection of plant conditions, and test of plant systems where appropriate,

d. interviews of plant, design, construction, and operational support personnel.

2.3 Summary of Findings

2.3.1 Personnel Access Issues

Access to certain equipment in areas such as the annulus, accumulator rooms, and valve rooms was found to be difficult. Personnel working in these areas will be exposed to potentially hazardous conditions. TVA management has recognized this and adopted procedures which will ensure employee safety if followed.

The purge air valve installation was not judged to represent a significant personnel hazard. This valve is properly installed but this installation does contribute to the congestion in the annulus because it partially blocks a personnel walkway. Corrective action on this installation was deemed unnecessary because of its remote location and the very infrequent employee exposure.

The method for removing the BFN main steam relief valve from the drywell area was judged to be a significant safety hazard. TVA management was made aware of this as early as 1979 but has to date not taken any significant corrective actions.

2.3.2 Main Steam Line Proximity Issues

The main steam lines of the plant were not found to represent a significant hazard to plant personnel whose work stations are in the vicinity. These lines were designed in accordance with all applicable safety codes. The calculated probability of a steam line failure in these lines is so low that there is no technical reason the access portal, secondary chemical laboratory, and other manned worked stations should be relocated.

2.3.3 Carbon Dioxide Fire Protection Issues

The CO_2 fire protection systems at SQN and WBN were designed in accordance with all applicable industry codes and legal requirements. There have been some accidental exposures of employees to CO_2 discharges. These accidents were primarily because of hardware difficulties or operational problems. As a result of the operating history of CO_2 fire protection systems and the potential for future accidental exposures, TVA has elected to replace these systems in its nuclear plants.

2.4 Summary of Collective Significance

2.4.1 Access Issues

TVA management was effective in recognizing potential employee hazards associated with working in confining and crowded plant areas and adopted procedures to ensure personnel safety. Employee effectiveness should not be effected if these procedures are followed. The technical adequacy of the design process was insufficient in the consideration of personnel access but has been revised to include this consideration for future designs.

The purge air valve issue arose principally because of the technical inadequacy in the design process not fully considering personnel access.

BFN management has been ineffective in correcting the known hazardous work activity associated with MSRV removal and reinstallation. Employee effectiveness is impacted by the existence of work hazards and the impression that management is not concerned by the existence of these hazards. The technical inadequacy of the design process contributed to the problem but an accepted design solution has been formulated.

2.4.2 Main Steam Line Proximity Issue

TVA management was responsible for the decision to locate work stations near steam lines. While this decision is technically defendable, they failed to fully consider the emotional aspect of this decision on employees and to adequately communicate to employees facts concerning the relative safety of nuclear plant steam lines.

2.4.3 Carbon Dioxide Fire Protection Issues

TVA management was effective in finding and correction problems with existing systems and recognizing the changing social acceptability of this method of fire protection. Employee effectiveness of employees working in CO 2 protected areas is reduced due to fears of accidental discharges of these systems. Technical adequacy of CO 2 fire protection systems in occupied areas is questionable.

2.5 Summary of Causes

2.5.1 Access Issues

These accessibility problems resulted from circumstances that were largely outside the control of the plant's designers. There are however, some examples such as the annulus, where greater attention to personnel access during design and construction would have resulted in better conditions.

The purge air valve problem is a result of inadequate design consideration about personnel access and a lack of understanding by plant employees as to how and when the valve operates.

The BFN MSRV problem is a result of BFN management failing to follow through with corrective action for a known personnel safety hazard that occurred because of inadequate design consideration.

2.5.2 Main Steam Line Proximity Issue

The steam line employee concerns resulted from lack of communication concerning the very low probability of a steam line accident at a nuclear plant.

2.5.3 Carbon Dioxide Fire Protection Issues

The CO_2 issues resulted from the changing social acceptability of the method. Even though there are reliable and proven safeguards that can be built into CO_2 fire protection systems, as long as the extinguishing agent is CO_2, the possibility of death from an accidental system discharge remains possible.

2.6 Summary of corrective actions

No generic corrective action was required. A problem was identified in Corrective Action Tracking Document (CATD) 90700-1 pertaining to the hazards associated with MSRV removal at BFN and the failure to implement DCR-1879. BFN management has determined that DCR-1879 may no longer be technically feasible. They will perform a thorough safety analysis of this operation prior to its next performance to insure extensive prejob planning which includes the proper equipment and tools necessary to safely perform this job.

3.0 EVALUATION PROCESS

The evaluation process was generally the same for each of the concern groups of this subcategory, and followed the basic guidelines of the Industrial Safety Category Evaluation Plan. The employee concerns which dealt with design considerations were subdivided into groups consisting of logical assemblages of like or similar employee concerns. Each group then provided a basis on which to conduct the evaluation. The specific evaluation methodology used for each of the three major issues of the Design Subcategory is presented below.

3.1 Evaluation Process for the Access Issue

Concerns about access were separated into three subgroups that were evaluated by slightly different methodologies.

3.1.1 Personnel Accessibility Issue

Case files on the subject employee concerns were first reviewed. Inspections were then conducted of the Reactor Building annulus, accumulator rooms, steam valve rooms, and other congested areas. Discussions were also held with construction and operational personnel.

Various documents such as Federal occupational health and safety documents, engineering procedures, engineering drawings, and design criteria were searched for evidence of or requirements for access consideration during the design process.

The following documents relate to the requirements for design access considerations or indicate the amount of access consideration that was actually conducted:

a. Title 29, Code of Federal Regulations, Part 1910, Subpart E, Articles 36 and 37, (29 CFR 1910.36, and 1910.37)

b. TVA Office of Engineering procedure OEP-06 (now NEP 3.2)

c. TVA's 47W200 series of drawings, "Equipment Drawings"

d. TVA's 48N400 through 48N407 series of drawings, "Containment Contract Drawings"

e. Chicago Bridge & Iron (CBI) Company drawings received on TVA contract Number 73 C 61-75320, "Containment Detail Design Drawings"

f. TVA Occupational Health and Safety Manual and TVA Occupational Health and Safety Program Plan contained therein

Informal interviews were then conducted with several design personnel who were known to have participated in the design of the plant at its inception. These interviews were conducted to determine the extent of access consideration given, the guidelines under which consideration was given, and any other pertinent information. Those interviewed consisted of a project engineer, one section supervisor, four mechanical and civil engineers, and three design engineering associates.

To gather input from the operations aspect, selected SQN personnel were interviewed to determine (a) what steps were involved in assuring safe access to cramped and crowded areas, and (b) how often access to such areas was required. Personnel included an Industrial Safety specialist, a Health Physics (HP) supervisor, maintenance health & safety coordinator, and an operations training unit supervisor. Discussions were then held with a member of the WBN Industrial Safety Staff pertaining to access in crowded spaces and with a public safety (plant security) supervisor pertaining to entry in to controlled areas such as the Reactor Building and annulus.

WBN plant hazard control procedures were then reviewed. Two procedures were found which addressed entry into such crowded areas: Hazard Control Instruction (HCI) G-8, "Working in Confined Spaces", and HCI-G-8a, "Working in Concealed Spaces."

3.1.2 Purge Air Valve Issue

The initial step in the investigation of this issue was the inspection of the valve installation. An inspection of the valve installation and operation was conducted on January 30, 1986, and witnessed by three people. Design drawings of the valve installation were then reviewed and the system designer was informally interviewed. Two valve procurement personnel were contacted to determine what restrictions were placed on the valve installation. Three designers responsible for seismic analysis were contacted about possible remounting of the valve operator. SQN operational personnel, a HP supervisor and an operations training supervisor, were also contacted to verify when the valve would operate.

3.1.3 Brown's Ferry Main Steam Relief Valve Issue

An inspection of the work location was made in January of 1986. This inspection was conducted with the general foreman responsible for the change-out of the MSRV's during each outage. Two employees, the foreman, and the general foreman who do the change-out work were interviewed. Medical records were searched for evidence of injuries received during this job, and the industrial safety and fire protection supervisor of the plant was also interviewed.

The assistant site director, two former outage managers, and a knowledgeable valve specialist were also interviewed. The design supervisor and a senior level engineer responsible for a proposed design modification (Engineering Change Notice, "ECN") to replace the jib cranes with a monorail and motorized hoist were consulted. Employee concern site personnel were consulted to see if similar employee concerns or previous investigations of this situation had been performed. The TVA Office of General Counsel was also contacted about possible criminal and financial liability aspects of this situation.

The ECN package of the proposed engineering change was reviewed. TVA correspondence on this situation and the requirements of the TVA Occupational Health and Safety Manual were also reviewed.

Section 3.3 of the TVA Occupational Health and Safety Program Plan is applicable to this issue. This section reads as follows:

All jobs shall be reviewed before the work is undertaken. Management shall be responsible for ensuring that these reviews are conducted as appropriate for anticipated hazards and associated risks. For those tasks determined by management to be high hazard activities, a formal prejob analysis may be necessary. High-hazard work is defined as any task that has caused or is likely to cause serious injury or death if not properly carried out.

In addition, Section 1-201 of Presidential Executive Order 12196, Occupational Safety and Health Programs for Federal Employees requires that the head of each Federal Agency "shall furnish to employees, places and conditions of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm."

Although the work process in question could not be observed, this is not considered significant since the great majority of personnel interviewed, and available TVA documents, were in agreement about the hazards of the work.

3.2 Evaluation Process for the Steam Line Issue

Previous responses to the concerns comprising this group were first reviewed. This concern group contains employee concerns at both SQN and WBN.

The physical installations of the access portal, secondary chemical laboratory, and the turbine oil tanks were inspected.

TVA correspondence on the development of the "power block" concept was reviewed. Industry literature was searched for incidents of steam line breaks. The WBN Final Safety Analysis Report was reviewed for information dealing with postulated steam line breaks. Design documents, the hazard evaluation of the access portal siting at SQN, and the BFN Probabilistic Risk Assessment were also reviewed.

Interviews were conducted with three architects and three public safety managers who were involved in the design and implementation of the "power block" concept and its associated plant modifications. Three design engineers knowledgeable about the main steam system and the consequences of a postulated steam line break

were consulted. Two nuclear engineers knowledgeable in probabilistic risk assessment were contacted about the potential of a main steam line break. The design services manager at SQN was contacted to discuss that plant's planned actions as a result of the formal hazard evaluation of the access portal siting. Two design engineers in TVA's fossil and hydro power program who work with steam line break problems were contacted for information. And a member from both SQN's and WBN's Industrial Safety staffs were contacted.

Sufficient information was collected to (a) indicate that the probability of a steam line break occurring is very low, (b) verify that the determination of this probability is reliable, (c) verify that the doors to the Control Building near the turbine oil tanks will receive only very restricted use, and (d) determine that appropriate measures have been taken near the turbine oil tanks to ensure that personnel are not unduly endangered. No further evaluation steps were deemed necessary.

3.3 Evaluation Process for the Carbon Dioxide Fire Protection Issues

The two basic issues addressed by this evaluation were investigated through various avenues. The allegations of specific deficiencies were evaluated principally through physical inspection of the installations, tests, and interviews of knowledgeable individuals. The anxiety issue additionally involved the review of TVA and industry accident experience, industry codes and standards, published literature, TVA correspondence pertaining to the system, and TVA design documents.

Interviews were conducted with three fire protection design engineers, the WBN fire protection engineer, a SQN fire protection engineer, two safety specialists from the WBN safety staff and one from the SQN safety staff, and the supervisor of the WBN safety and fire protection section. Also, interviewed were the chief of security, a construction engineer, an assistant shift engineer, an assistant unit operator, and two employees from the Central Alarm Station at WBN.

The alarm system in the diesel generator building was tested to determine if the horns could be heard above the sound of the diesels when operating. The associated warning light system was also evaluated.

The following documents relate to this issue:

a. National Fire Protection Association Standard 12, "Standard on Carbon Dioxide Extinguishing Systems" (NFPA 12)

b. Fire Protection Engineers Handbook, Section 18

c. TVA drawings 47W843-series and 47W590-series

d. TVA memorandum SOO 860321 801, dated March 27, 1986 from H. L. Abercrombie to C. C. Mason

e. TVA memorandum LO1 860403 833, dated April 15, 1986 from C. C. Mason to W. C. Drotleff, Jr.

f. Occupational Safety and Health Administration (OSHA) standards contained in Chapter 29, Code of Federal Regulations, Part 1910, Subpart L, Article 160 (29 CFR 1910.160)

The requirements or performance standards for the CO_2 fire protection system come from two sources. Minimum legal requirements for the systems provided at SQN and WBN are given in OSHA standards 29 CFR 1910.160. Applicable requirements are:

a. Effective safeguards shall be provided to warn employees against entry into discharge areas,

b. Warning or caution signs shall be posted at entrances into and inside of protected areas,

c. Systems shall be inspected annually,

d. Emergency action plans shall be established,

e. A predischarge alarm which is capable of being perceived above ambient light or noise before system discharge which will allow safe exit for employees before discharge shall be provided, and

f. Automatic activation of the system shall be by means of an approved fire protection device installed and interconnected with a predischarge alarm.

While the OSHA standards supply minimum legal requirements, the systems are usually designed and operated in accordance with NFPA 12. Section A-1-6.1 of NFPA 12 provides the following pertinent information:

a. "Although carbon dioxide is only mildly toxic, it will definitely produce unconsciousness and death when present in fire extinguishing concentrations. The action in this case is more related to suffocation than to any toxic effect of the carbon dioxide itself."

b. "At carbon dioxide concentrations above 9 percent, personnel would quickly lose consciousness. At concentrations of about 20 percent, death would follow in about 20 to 30 minutes, unless the victim was removed to a source of fresh air. Recovery with artificial respiration is usually rapid because of the natural tendency of carbon dioxide to promote breathing.

Safety requirements are provided in NFPA 12, section A-1-6.2 which reads as follows:

The steps and safeguards necessary to prevent injury or death in areas whose atmospheres will be made hazardous by the discharge of carbon dioxide may include the following:

a. Provisions of adequate aisleways and routes of exit and keeping them clear at all times.

b. Provisions of the necessary additional or emergency lighting, or both, and directional signs to ensure quick, safe evacuation.

c. Provision of alarms within such areas that will operate immediately upon activation of the system on detection of the fire, with the discharge of carbon dioxide and the activation of automatic door closures delayed for sufficient time to evacuate the area before discharge begins.

d. Provisions of only outward swinging self-closing doors at exits from hazardous areas, and where such doors are latched, provision of panic hardware.

e. Provision of continuous alarms at entrances to such areas until atmosphere has been restored to normal.

f. Provision for adding an odor to the carbon dioxide so that hazardous atmospheres in such areas may be recognized.

g. Provision of warning and instruction signs at entrances to and inside such areas.

h. Provisions for prompt discovery and rescue of persons rendered unconscious in such areas. This may be accomplished by having areas searched immediately after carbon dioxide discharge stops by trained men equipped with proper breathing equipment. Those rendered unconscious by carbon dioxide can be restored without permanent injury, by artificial respiration, if removed quickly from the hazardous atmosphere. Self-contained breathing equipment and personnel trained in its use, and in rescue practices including artificial respiration, should be readily available.

i. Provision of instruction and drills of all personnel within or in the vicinity of such areas, including maintenance or construction people who may be brought into the area, to insure their correct action when carbon dioxide protective equipment operates.

j. Provision of means of prompt ventilation of such areas. Forced ventilation will often be necessary. Care should be taken to readily dissipate hazardous atmospheres and not merely move them to another location. Carbon dioxide is heavier than air.

k. Provision of such other steps and safeguards that a careful study of each particular situation indicates are necessary to prevent injury or death.

"Anxiety" Issues

The requirements or performance criteria for the anxiety issue are less exact and defendable than those of the hardware issue. The most pertinent regulatory requirement is OSHAs "general duty clause," Section 1-201 of Presidential Executive Order 12196, Occupational Safety and Health Programs for Federal Employees. This section

requires that the head of each Federal agency "shall furnish to employees places and conditions of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm."

4.0 FINDINGS

The issues addressed by this subcategory may apply at other ONP sites. The findings and conclusions of the personnel access and main steam line issues for example, may have universal implications. Such aspects are being addressed through the development of ONP Standard (which are generic documents for all of ONP) and site procedures (which are site-specific documents).

The findings and conclusions of this subcategory report are not in conflict with any findings and conclusions generated as a result of previous investigations of the employee concerns addressed by this report.

The findings for this subcategory are presented below by issue and "subissue" where appropriate.

4.1 Accessibility Findings

Findings relative to the accessibility issue are seperated below into the three subdivisions by which they were evaluated.

4.1.1 Personnel Accessibility

4.1.1.1 Discussion

Site-Specific Discussion - Watts Bar

Inspection of areas such as the Reactor Buildings, annulus, accumulator rooms, and valve rooms verified that the conditions described by the concerned individuals existed. The following is a summary of the findings by concern.

IN-85-841-001 - The amount of hangers installed in the plant do have some impact on personnel accessibility to some areas. These conditions must be taken into account when planning work in these areas.

IN-85-746-001 - There is a large amount of "support bracing" installed in certain areas of the plant. None of this is "unnecessary" since it is required because of various nuclear safety considerations. The known congestion within these problem areas must be taken into account when work planning is done.

IN-85-861-002 and IN-85-906-001 - The reactor building accumulator rooms are very congested. Access to these areas is regulated, and work in these areas must be planned in advance.

IN-85-189-003 - It is true that there is only one set of ladders to all levels in the annulus, but this represents an inconvenience rather than a safety hazard. However, on certain levels of the annulus it is virtually impossible to walk half way around due to the amount of equipment or because of containment stiffeners. In these instances, local ladders to another level could be added or some other solution to the access problem implemented.

IN-85-098-001 - The design of the plant did take into consideration personnel access requirements. However, due to many factors beyond the control of designers, several areas developed into very congested places. There are also some instances where this evaluation has determined that inadequate consideration of personnel access requirements has occurred. Such areas are more congested than they should have been.

There are Occupational Safety and Health Administration (OSHA) Standards pertaining to emergency egress from occupied areas that TVA has been required to follow since 1980. A great many of the areas cited in the employee concerns of this concern group are not generally considered as "occupied." Therefore, the OSHA standards should not be applied to these areas. However, personnel access to various plant equipment is an obvious operational requirement, and existing access in several areas is far from ideal.

This access problem was recognized during the design of the plant and certain steps were taken to lessen its impact. For example, aisle space designations were added to the plant equipment

drawings in 1977 (47W200 series, originally issued 1971), and an access task force was formed to improve access where possible. The access task force has been responsible for the addition of several platforms and chain-wheel valve operators to help improve access to certain equipment. This task force continues to function.

Discussions with various designers involved in the early part of the plant design indicated that consideration of personnel access was not a formal step of the design process when the design of WBN was initiated. Those interviewed indicated that personnel access was considered as a "common sense" or integral part of the design process.

But as the design progressed, equipment that was not initially anticipated was added to the plant. Features such as redundant system operational capability and additional nuclear safety systems were added and contributed to crowded conditions. The number and size of pipe hangers, support bracing, and pipe whip restraints were dictated by seismic design criteria and the concern for nuclear safety. These requirements were revised several times since the inception of the plant design which required additional and larger bracing. Adequate space for the addition of these features was not always available in the existing design of the plant. Thus, many areas of the plant are less accessible than originally planned. In many cases, however, greater attention to design could have resulted in better personnel accessibility conditions. The annulus is one case in point.

Access to the annulus is obtained from the 713 elevation of the Auxiliary Building at Reactor Building azimuth 45. From there, a ladder descends to elevation 702-9 in the annulus.

Access to higher levels is obtained by a single set of caged ladders located between azimuth 164 and azimuth 168. Design drawings of the containment vessel (TVA contract 73C61-75320) show that the access ladders and walkways were provided as part of the original design. This indicates that personnel access requirements were being considered in the early phases of the design.

However, these drawings and the pertinent TVA drawings (48N400 through 48N407) show that a number of interferences with the walkways were established early in the design phase through the location of containment penetrations. This indicates that the design review of these drawings from a personal access viewpoint was inadequate. In addition, there are a significant number of interferences between the vertical stiffening ribs of the containment vessel and the walkways. The vertical stiffening ribs and the intermediate horizontal stiffening ribs without walkways do not appear on the TVA drawings. They were added by CBI during the detailed design.

The resulting access problems created within the walkway spaces indicate that the contract drawings also received inadequate design review with respect to personnel access.

4.1.1.2 Findings/Conclusions

Generic Findings/Conclusions

The two issues addressed by this report are substantiated. However, recognition of deficiencies within the design process has occurred, and measures have been taken to ensure that access considerations are part of the design process. There are many plant areas where personnel accessibility is far from ideal, but with proper precautions personnel can work safely in these areas.

Crowded conditions are not unusual around power plants, and such conditions are often encountered in other plants within the TVA system and at other utilities.

As mentioned above, design personnel indicate that access to various areas and equipment was an individual consideration and not a formal, documented design step. The design process was revised on newer plants that were planned after Bellefonte Nuclear Plant, with the intent of providing better access to plant equipment.

Such techniques as three dimensional modeling were developed and used to minimize the accessibility problems in later plant designs. As a result of the recognition of access as a formal design consideration, Office of Engineering Procedure OEP-6 (currently NEP 3.2), as issued in 1985, contains line item check lists that include access as a design input.

Site-Specific Findings/Conclusions - Watts Bar

While the design process has been revised to avoid accessibility problems on future plant designs, this does not readily resolve those problems at WBN. The solution to accessibility problems is often very expensive. The benefit from a single improvement may provide little additional safety for personnel.

Since appropriate recognition of the problem has been made, steps have been taken to minimize the hazards to personnel. Due to efforts of the access task force, improvements to access are being evaluated on the basis of severity of hazard, frequency of access, cost benefit to plant operation, and similar factors.

The safety of personnel working in cramped and crowded areas has been considered by TVA management. Policies have been adopted which reduce the potential for personnel injury through careful prejob planning and by taking precautions to prevent mishaps. Such precautions are a requirement of the TVA Occupational Health and Safety Program Plan. They are implemented in plant procedures such as WBN HCI-G8a.

These plant safety procedures require such measures as (a) constant communication or frequent check-in when working in confined or limited access areas, (b) the use of the buddy system to insure that help is available in emergencies, and (c) the use of personal protective equipment.

In addition, entry into controlled areas such as the annulus and accumulator rooms requires a written work plan and a radiological work permit. Public Safety monitors entry into these areas as

part of the plant physical security control. Thus several measures are in place to ensure the safety of plant employees working in cramped and crowded areas.

Based on the above findings, while personnel access within certain areas of the plant is difficult, existing site procedures and policies which recognize and mitigate this problem are in place. Work within these congested areas can be conducted safely by conducting adequate prejob planning and by following such existing procedures and practices.

4.1.2 Purge Air Valve Findings

The issue as stated is not substantiated. The hazard presented by the valve during operation has little potential of causing an injury. The valve's operator does partially block a walkway, but egress past this valve is comparable to or slightly better than other locations within the annulus.

4.1.2.1 Discussion

Site-Specific Discussion - Watts Bar

Purge air valve 2-FCV-30-54 is a 24-inch butterfly valve provided with remote operational capability by an approximately 10-inch diameter by 42-inch long air operated cylinder. A review of the final safety analysis report indicated that this valve serves as the air inlet for exhausting and replacing the air within the annulus prior to personnel entry.

Discussions with SQN operations personnel indicated that the annulus is entered approximately once per day during normal plant operation and that it is normally purged prior to entry. This area is a concealed space as defined in WBN HCI-G8a, and requires prejob planning and a radiological work permit in order to gain entry. In addition, public safety monitors entry into and exit from this area.

Field inspection of the valve installation verified that the valve is installed in a congested area. There are at least three very cramped and congested areas on the way to the valve regardless of the route chosen.

The valve is installed at centerline elevation 730 feet, approximate azimuth 38 degrees within the unit 2 Reactor Building annulus. To obtain access to the various penetrations and equipment to be installed within the annulus, 28-inch wide walkways were installed on every other horizontal stiffening rib of the containment structure.

The operating cylinder of the purge air valve hangs down within the space of the walkway located at elevation 724, 6 inches to within about 14 inches of the walkway surfaces. A space of approximately 12-inches wide by 44-inches high remains between the vertically-oriented operator cylinder and the walkway railing.

In order to pass by the valve one must squat down and pass under the valve stem and between the operating cylinder and the valve body. This requires straddling the operating cylinder for a short period of time.

The unit one installation of this valve was inspected and found to be essentially identical. The area around the unit one valve is slightly less congested because of a different configuration of other equipment in the area.

4.1.2.2 Findings/Conclusions

Site-Specific - Watts Bar

Observation of the actual operation of this valve was made on January 30, 1986. The valve operator swings through an arc of about 6 inches at the lower end of the cylinder. The end of the cylinder moved upward and in the direction of travel on the walkway, not across it as would be required for a crushing injury.

The movement was very slow and preceded by a noticeable noise. Evaluation of the installation verified that this is the movement to be expected by the cylinder.

Design personnel indicated that the valve is installed according to design specifications, but that another orientation of the operating cylinder is possible. However, this is not likely to be of any significant benefit if it is the only action taken within the annulus.

Indications are that the valve will operate prior to personnel entry into the annulus. Thus exposure to the moving cylinder is unlikely. There is also a very low probability that a unexpected movement of the valve could cause a crushing or pinching injury.

4.1.3 Brown's Ferry Main Steam Relief Valve Findings

A field visit to the work location verified that the work is done in a very cramped and crowded location. The evidence from past removals and reinstallations of these valves (MSRVs) is present in the form of battered and deformed pipe insulation.

4.1.3.1 Discussion

Site-Specific Discussion - Brown's Ferry

These valves serve to remove excess pressure from the reactor during accident conditions. They are located in the drywell area of the Reactor Building. The drywell is a radioactive, very crowded and often very hot area surrounding the reactor vessel. The original design provided a series of "jib" cranes (pivoting boom type devices) for moving heavy equipment within the drywell.

The MSRVs each weigh approximately 1380 pounds. They are presently removed from their installation by being lifted with a chain fall or "come-along" cable puller. They are then attached to a chain fall from the adjacent jib crane. As one chain fall is released, the other is taken in, swinging the valve from one jib crane to the next. This operation is

repeated several times (up to 4 times) until they reach the point where they can be lowered to the elevation below. The valves can then be removed from the drywell area for testing. There are thirteen main steam relief valves that must be removed from each reactor and tested each time the reactor is refueled. After testing, the valves must be re-installed using the same process.

An internal memorandum, dated August 1, 1979, outlined the work procedure as it is essentially still done. this memorandum was from the outage safety engineer at the time to the outage director. The concluding paragraph of that memorandum is quoted below.

With this area being as confined as it is, the dress requirements (C-zone clothing), and the manner in which we are using the lifting and hoisting devices, it is my opinion that we are taking serious risk and the potential for a very serious accident is great. I feel the problem should be looked into at the beginning of the next outage so that some recommendation and course of action can be taken on this matter immediately.

In apparent response to the safety engineer's memorandum, a Design Change Request (DCR BF-DCR-1879) was prepared to provide a monorail with motorized hoist on the second elevation of each drywell to move MSRVs. It also established a route through an opening in the deck grating for removing and replacing the MSRVs from the drywell. The current removal route is down a ship's ladder opening.

The DCR stated that this work "must be performed at the earliest opportunity." ECN P-0717 was assigned to this DCR. During the evaluation of this issue, the engineer responsible for ECN-P-0717 stated that preliminary design work had been done but that the detailed design had not been completed since "this activity was never placed on the outage schedule and with present work items, we have not been able to work as a side activity to have the design ready in advance of implementation."

Interviews with former and present plant management personnel offered the opinion that this job can be done safely. But a memorandum, dated February 20, 1985, from the present safety and fire protection supervisor to the then plant manager indicates otherwise and provides some history of the subject DCR. The following are some significant statements from that memorandum:

". . .the DCR was approved and scheduled for implementing on unit 3, cycle 5, modifications but was deleted. It was put on the unit 1, cycle 6, modifications list but was again deleted. It is now scheduled for the unit 3, cycle 6, modifications list but. . .says it will probably be cut again.

. . .the removal and replacement of these valves is presently performed in a manner which creates several serious potential hazards and exposure to personnel and equipment. Several injuries including lost-times have already occurred from this operation. There is a potential for a fatality under the present procedures. Evaluations of other alternatives have not proven successful and it is believed that this is the only solution to the problem.

. . .the plant health and safety committee has identified this modification as one of their top priorities for implementing, and the modifications group who perform work agree that it is a real serious problem."

This memorandum requested that the DCR be placed back on the modifications list for unit 3, cycle 6 and that it not be deleted again from the outage modifications. The hazardous nature of MSRV removal and re-installation was substantiated in interviews with the crafts performing the MSRV work, their supervision, a valve specialist familiar with the job, and present and former plant management. This serves to substantiate the contention that the method for pulling the main steam relief valves is an industrial safety hazard that has been brought to the attention of TVA management many times.

A review of plant medical records was unable to verify any specific injuries associated with this job. There were a number of injuries that were stated to have happened in the drywell. A number of those interviewed stated that injuries and near misses had occurred.

The most impressive near miss reported occurred when a cable puller slipped loose and pinned an outage worker between the MSRV being moved and a pipe. The worker only sustained a bruise, but a fatality or disabling injury could have resulted.

4.1.3.2 Findings/Conclusions

Site-Specific Findings/Conclusions - Brown's Ferry

Based on the findings above, the issue concerning the safety of the current method of removing and reinstalling MSRVs at BFN is fully substantiated.

Thirteen MSRVs are removed for testing and subsequently re-installed during each outage. This operation has been done at least fifteen (15) times. The original design did not provide suitable means to accomplish this job.

The design personnel interviewed indicated that the monorail would not necessarily solve all the identified problems. Even so, every person contacted during this evaluation agreed that the present method is very hazardous. Even with the monorail modification this will still be a difficult job.

The evaluation of this employee concern determined that the hazards associated with this job have been addressed only marginally . The failure of TVA to work DCR 1879 into an outage has indicated that the Executive Order requirement to provide a work place free of "recognized hazards" has not been complied with. The hazards of this operation have been recognized for a long time. Even with this recognition, the only generally acknowledged correction of this hazard has been postponed many times.

4.2 Steam Line Findings

The issue addressed by this section relates to the fact that occupied areas within the plant at WBN and SQN (and at other plant sites) are located in the vicinity of the main steam lines. In the event of a sudden and sufficiently large main steam line rupture, significant damage and loss of life is likely. However, the concerns about steam line ruptures are not substantiated since the probability of such an occurrence is extremely remote. The concern about the main turbine lube oil tank being close to control building access doors is also not substantiated since the subject doors are locked and will not serve as primary exits.

4.2.1 Discussion

4.2.1.1 Generic

There have been failures in steam piping at some fossil plants. One recent failure occurred at Mojave Coal Plant (Southern California Edison) on July 9, 1985. A 30-inch reheat line carrying steam at 1000 degrees Fahrenheit and 600 pounds per square inch gauge (psig) sustained an 18-foot long rupture along a weld line in a portion of the piping located next to the plant's lunch room.

The force of the blast breached a wall between the lunch room and the plant's control room. Debris damaged part of the control room sufficiently that both of the plant's units were put out of commission. Ten workers were killed immediately and 13 others were seriously injured. Four of the injured later died.

No main steam line failures of this type have been reported at a nuclear power plant. This is generally attributed to the operating conditions of the pipe. Fossil plant main steam pipe operate at temperatures of 1000 degrees Fahrenheit and above. At this temperature, a property of steel know as "creep" becomes an important concern. Steels will "flow" under stress at elevated temperatures. After a certain time, usually 30 to 50 years, the pipe walls become thinner, minute imperfections such as cracks will grow, and a

failure will eventually occur. The main steam lines at WBN are designed to operate at no more than 1185 psig, but no hotter than 600 degrees Fahrenheit, and will contain no more than 0.25 per cent moisture. This is in the temperature range where creep has proven not to be a significant factor.

There have been a few failures of extraction steam lines at nuclear plants which may have contributed to concern over main steam failures.

At Trojan Nuclear Plant (Pacific Gas & Electric) on January 9, 1982, the high pressure turbine extraction steam line to feedwater heater 5B ruptured, releasing steam into the turbine building. The reactor was manually tripped. No employees were reported hurt in this accident.

At Oconee Nuclear Power Plant (Duke Power) on June 28, 1982, a four square foot rupture occurred in a 24-inch steam extraction line. The escaping steam caused burns to two workers who were hospitalized overnight and released. Some plant electrical equipment was also damaged.

Both of these failures were attributed to pipe wall erosion. Extraction lines typically run at lower pressures (450 psig to as low as 75 psig) but with a 16 to 18 percent moisture content which creates an erosion problem. WBN's main steam lines will run with no more than one quarter per cent moisture (0.25%). Erosion related failures similar to extraction line failures are not to be expected in those lines.

4.2.1.2 Site Specific - Watts Bar and Sequoyah

A review of the area in the vicinity of the turbine lube oil tanks indicates that there are two doors to the Control Building within 60 feet of the main turbine lube oil tanks located on elevation 729 at WBN (elevation 706 at SQN). These entrances are equipped with sliding fire doors and locked and secured with caged exits in accordance with security provisions. Thus the doors in question will not serve as normal egress to, or from, the control building. The turbine lube oil tanks are provided with fire protection in the event of an accident.

Since the doors are not under heavy usage and fire protection is provided, the issue is not substantiated.

TVA developed the "power block" security concept in 1982 to reduce the NRC-required security area, and make the security operation more efficient. These secured areas are collectively known as the "power block."

After study, the decision was made to locate a personnel access portal between columns M & K and T-1 and T-2 on elevation 708 (elevation 685 at SQN) of the Turbine Building. This is a search and security check-point similar to an airport security station which regulates access into the power block areas.

This portal location is directly beneath four 36-inch diameter main steam lines that carry steam from the steam generators to the main turbine. At a later date, the Secondary Chemical Laboratory was located in a similar location under the steam lines on the unit 2 side of the plant. This laboratory supports chemical aspects of the plant's operation. Also located nearby is the health physics dosimetry station and the secondary chemical lab (unit 2 side). There are also other "temporary" work stations located close to steam lines which would most likely be involved should a steam line rupture suddenly and catastrophically.

The postulated "worst case" steam line rupture for the area of the portal would be detected within 3 seconds and the main steam isolation valves would close within 5 seconds. Thus, the energy release of a main steam rupture would be for a maximum of 8 seconds. The temperature excursion in the vicinity of the portal would be to a maximum of 317 degrees Fahrenheit while the maximum pressure on the portal would be about 2.88 psig (over 400 pounds per square foot). The hot steam released by such a postulated accident would severely burn or kill anyone in the area of the rupture, and would be of sufficient force to damage the portal.

4.2.2 Findings/Conclusions

4.2.2.1 Generic

The probability of the occurrence of a catastrophic major steam line rupture at one of TVA's nuclear plants is considered to be highly improbable.

4.2.2.2 Site Specific - Watts Bar and Sequoyah

A formal assessment of the hazards of the access portal location performed for SQN indicated the probability of a pipe rupture is 9.18×10^{-9} breaks for each hour of operation. This determination is based on the technique developed for the BFN Probabilistic Risk Analysis by TVA and the firm of Pickard, Lowe, and Garrick, Inc. (nuclear power consultants with extensive experience in probabilistic risk assessment).

There is little doubt that if one of the steam lines in the vicinity of the access portal should rupture loss of life would occur. However, this does not establish the validity of the employee concerns comprising this group, because the likelihood of a break is so small.

Nevertheless , because of the concern for nuclear safety, steam line breaks have been given serious consideration even though the potential for such breaks is extremely low.

The calculated chance of pipe rupture at WBN is one in 108,932,502 for each hour of exposure. Few plant employees are exposed to the steam lines for more than an hour a day. For those employees spending 8 hours in the portal or nearby the probability of death occurring from a pipe rupture is 7.34×10^{-8} or one in 13, 623,978. According to risk assessment sources, such as the International Commission on Radiological Protection, individual members of the public accept a risk of (10^{-6}), (one in 1,000,000), without any hesitation. Since the individual risk to access portal staff is more than 13 1/2 times less than this "acceptability" of occurrence, employees should fear the steam lines no more than any other plant hazard.

The access portal location represents an acceptable level of risk.

4.3 Carbon Dioxide Findings

Carbon dioxide fire protection systems have been widely used for many years throughout most major industries to extinguish flammable liquid fires, gas fires, and fires involving electrically energized equipment. As such, CO_2 fire protection systems were the natural selection for several fire protection applications at WBN, SQN, and other TVA power plants.

There are two basic groups of concerns about these CO_2 systems. The first group is mainly about the "hardware" issue and involves several suspected or actual deficiencies associated with the CO_2 fire protection system. The second deals principally with an "anxiety" issue. This anxiety may be the overriding question in the CO_2 concerns because CO_2 fire protection systems can pose a threat of asphyxiation to plant employees. The findings involving the eight employee concerns making up this issue are summarized below by concern group.

4.3.1 Discussion

4.3.1.1 Generic

Carbon dioxide is a naturally occurring, colorless, odorless, tasteless, nontoxic gas. In the concentration necessary for effective fire suppression (usually 30 to more than 50 percent), it presents an asphyxiation hazard. Most people exposed to a concentration of 9 percent CO_2 lose consciousness within a few minutes. If an unconscious person breathes a high enough concentration of CO_2 for a sufficient period of time death will result. If a CO_2 fire protection system discharges the potential for suffocation is present until the gas dissipates.

The recommendations of NFPA 12 presented in section 3.3 are not legal requirements. However, interviews with TVA design personnel and plant fire protection personnel, a review of the design drawings, and a review of the design criteria of the carbon dioxide fire protection system all indicate that TVA generally follows NFPA 12 requirements.

4.3.2 Findings

4.3.2.1 Findings - Watts Bar and Sequoyah

Since the findings relative to the CO_2 fire protection system at WBN and SQN are interrelated, they are discussed collectively below.

Two exceptions to NFPA 12 recommendations were identified during this evaluation. One exception is that several doors open counter to the path of exit from CO_2-protected areas. This occurs at both SQN and WBN. The other is that the alarm system in the WBN Diesel Generator Building is inadequate.

"Hardware" Issue

The findings for each employee concern dealing principally with the CO_2 "hardware" issue are summarized below by concern.

EX-85-022-001 - Interviews with WBN public safety and WBN employees working in CAS indicated that the currently available breathing devices are adequate, both in size and number. Those CAS personnel interviewed indicated that based on the time required to evacuate the area, the existence of alarm horns nearby, the fact that firedoors are between the CO_2 protected rooms on elevation 708 and the exit stairwells, additional breathing devices are not needed.

Dump tests that have been conducted by the plant safety staff indicate that CO_2 does not leak down to this level in any appreciable amounts. Thus ample time is available to permit orderly evacuation of the CAS area even without the use of the breathing devices.

IN-85-892-001 - Wintergreen odorizer cartridges are removed only for pre-operational testing and periodic "puff" testing. This is because the odorizer cartridges operate through a fail-safe rupture disc design that ensures that the odor is released any time the discharge piping is charged with carbon dioxide gas. The cartridges are reinstalled prior to the system placing back into operation.

IN-85-918-003 and WBN-0299 - A test of the alarm system in the diesel generator building on December 11, 1985 verified that the alarm horns could not be heard clearly over the engine noise. Based on this, a recommendation was made to replace the existing warning lights with a brighter system to augment the audible alarms.

IN-86-048-001 - There are no CO_2 alarms or monitors in CAS. Personnel in the CAS had trouble hearing the CO_2 alarms. Because of this, an alarm horn has since been located in the corridor immediately outside the CAS.

"Anxiety" Issue

The findings for each employee concern primarily dealing with the anxiety issue are summarized below by concern.

EAC-85-003 - It is assumed that the CO_2 "hazard" on elevation 669 at SQN refers to the CO_2 fire protection system since no other sources of CO_2 are present on this elevation. This system has been designed in accordance with all applicable legal and industry standard requirements being considered. Several features for employee protection are incorporated into the system design. In addition, plant administrative procedures are in effect which further serve to ensure the safety of employees in this area.

RMM-85-004 - CO_2 alarms are one of the subjects that are covered in General Employee Training (GET) 1.1 In addition, the alarm system is tested periodically so that employees who work in the areas should be familiar with its sound. Such information as this should also be covered in supervisory orientation of the employee. As part of the operational policy, the shift engineer announces when a CO_2 dump has occurred. Baring any of these sources of information, employees not familiar with the sound of the CO_2 alarm should evacuate any area which is posted as being protected by CO_2 whenever any alarm goes off.

WBN-241 - Current policy at WBN is that the CO_2 system in the Diesel Generator Building can be valved out whenever whenever requested. Work is permitted with the CO_2 system in automatic but only when the safety of personnel is not jeopardized. It is the supervisor's responsibility to advise the shift engineer whenever circumstances warrant the isolation of the CO_2 system.

The anxiety aspect of this element is a difficult one to address. Industry experience shows that personnel exposures to CO_2 gas do occur. Although many CO_2 fire protection systems have been installed throughout the country, there have been few reported accidental deaths. But it is indisputable that CO_2 in concentrations required for effective fire suppression can cause death.

Whether CO_2 fire protection systems constitute a "recognized hazard" depends upon the industry's willingness to accept the potential for accidental system discharges and resultant personnel exposures. TVA has decided not to face this possibility.

Accidental discharges of CO_2 fire protection systems, although infrequent, have occurred. A recent study performed by the Industrial Safety Staff of the TVA Division of Nuclear Services reviewed four events where personnel were inadvertently exposed to discharges of CO_2 fire protection systems (referenced TVA memorandum LO5 860310 801). These are summarized below.

a. Hope Creek Nuclear Plant, September 5, 1985

Ten tons of CO_2 gas from the fire suppression system was inadvertently discharged into the "A" emergency diesel generator fuel storage tank room due to a malfunction of the CO_2 control panel. Sixty eight (68) employees were affected. Twenty one (21) were transported to a hospital for treatment.

The failure was attributed to a short circuit in the control panel caused by moisture that entered through conduit and conduit openings in the top of the panel.

b. Catawba Nuclear Plant, June 8, 1983

During a test of the CO_2 system for the 1A diesel generator room, approximately 6,500 pounds of CO_2 was accidently discharged. The release was unannounced since the alarms had been disconnected for the test. Thirteen (13) personnel were affected. They were transported to a hospital and released the same day.

This discharge resulted when an electrician mistakenly read the position of two valves used to valve out the system. As a result they were locked in the "open" position rather than than "closed" position. The system had not been fully turned over to operations and the electrician had also overlooked the operations tags on the valves.

c. Sequoyah Nuclear Plant, September 26, 1978

While construction and maintenance activities were going on a simultaneous discharge of CO_2 to all areas of the diesel generator building occurred. This release was unannounced and visibility quickly became limited due to the discharge "fog." All employees eventually exited from the building, the last two of which collapsed upon exiting. Nine (9) employees received medical treatment and returned to duty. One was later hospitalized for the observation and treatment of injuries received during the evacuation.

The accident was initiated by the inadvertent operation of an unprotected switch which opened the master CO_2 selector valve pilot valve solenoid. Manual actuators to the local hazard valves were mislabeled resulting in the valves being open which allowed the release of the CO_2 to the protected areas.

d. Brown's Ferry Nuclear Plant, May 26, 1976

During a test of the concentration of discharged CO_2 in the oil purification room a simultaneous unalarmed discharge occurred in the unit 3 computer room.

The five employees who were in the computer room at the time exited upon noticing the CO_2 discharge and notified the shift engineer of the incident. The incident subsequently resulted in four (4) employees, including an assistant plant supervisor, and two section supervisors being overcome by CO_2. The four unconscious employees were revived on the scene.

A partially open pilot valve on the local selector valve to the computer room was found to have caused the incident. Corrosion was found to have prevented the valve from seating properly.

While all of the incidents discussed above resulted in employee exposure of CO_2 gas, prompt action, evacuation, and rescue efforts were able to prevent any fatalities. All the incidents were caused by hardware and/or operational deficiencies which were corrected. These incidents were used in the Industrial Safety Engineering staff study above to illustrate that CO_2 accidents are predictable occurrences.

4.3.3 Conclusions

4.3.3.1 Generic

Carbon dioxide is an effective fire suppressant. It has several properties that make it desirable for that use: (a) it is noncombustible, (b) it does not react with most substances, (c) it provides its own pressure for discharge, and (d) it can penetrate and spread to all parts of the fire area. Since it does not conduct electricity and leaves no residue, it can be used on energized electrical equipment, computers, and instrumentation. However, since it does not support life, its use within occupied areas can be dangerous.

In recent years, other extinguishing agents such as halon for electrical areas and foam-water spray systems for oil fires have begun to replace CO_2.

4.3.3.2 Site Specific - Watts Bar and Sequoyah

This evaluation revealed that the exit doors from several areas at SQN and WBN that are protected by CO_2 fire protection systems open counter to the direction of emergency exit. This is the case in the

computer room and the auxiliary instrument rooms in the Control Building, and in all four electrical board rooms in the Diesel Generator Building. A system discharge of CO_2 gas will result in a pressure differential across these doors for up to a minute. Because of this, these doors will be very difficult to open for a period of time after release of the CO_2 gas. Unless employees are well trained and know what to expect, panic is very likely in these instances.

In order to address the door problems, both plants had issued DCR's to add abort switches in these CO_2-protected areas which would interrupt the discharge. This would have allowed employees to stop the gas discharge until everyone in the area could be evacuated. The WBN plant safety staff had also committed to upgrade the alarm system in the WBN Diesel Generator Building. However, these efforts have been abandoned since the decision has been made to replace the systems at both plants.

The SQN Safety Staff performed a detailed study of CO_2 fire protection system hazards (reference TVA memorandum S53 860102 990). As a result of these studies SQN has requested that all CO_2 fire protection systems in occupied areas be replaced with a system that presents less of a personnel hazard (reference TVA memorandum S00 860321 801). This request included a recommendation that this be done at all of TVA's nuclear plants.

The WBN Industrial Safety staff also recommended that its CO_2 fire protection systems be replaced with safer systems. Budgetary approval of this has been received as a fiscal year 1987 capital project. The safety staff is in the process of preparing a design change request (DCR).

In response to the SQN request discussed above, the Deputy Manager of Nuclear Power has directed the DNE to solve the problem of accidental CO_2 discharges (reference TVA memorandum L01 860403 833). As a result, efforts are presently underway to replace the CO_2 fire protection systems at all TVA nuclear plants.

5.0 COLLECTIVE SIGNIFICANCE

The following is a discussion of the collective significance assigned to each of the issues contained within this subcategory, and of the subcategory as a whole.

5.1 Access Issues

5.1.1 Personnel Access Issue

5.1.1.1 Management Effectiveness

Management has been effective in recognizing the potential employee hazards associated with work in confining and crowded plant areas at WBN. Procedures and policies are in place which, when followed, will result in adequate employee protection from the hazards associated with work in such areas.

5.1.1.2 Employee Effectiveness

The effectiveness of employees working in confining and crowded plant areas should not be an issue provided existing site procedures and policies governing access to such areas are enforced by management.

5.1.1.3 Technical Adequacy

While there are no specific established requirements governing access (as opposed to existing exit/egress requirements), the design process should have included formal consideration of personnel access. When WBN and SQN were designed, access consideration was not a formal part of the design process. However, this process now recognizes personnel access as a step in the design process.

5.1.2 Purge Air Valve Issue

5.1.2.1 Management Effectiveness

No collective significance assigned.

5.1.2 2 Employee Effectiveness

No collective significance assigned.

5.1.2.3 Technical Adequacy

The placement of this valve, which partially obstructs a walkway within the annulus, is the result of a lack of adequate consideration for personnel access during the ongoing design of systems and equipment within the annulus.

5.1.3 Main Steam Relief Valve Issue

5.1.3.1 Management Effectiveness

Management has been ineffective in correcting a known, hazardous work activity associated with the removal and subsequent replacement of these valves at BFN. Even though the problem is well documented, and a generally accepted design solution exists, the correction of the problem has been repeatedly postponed. This contributes to the impression that management is not concerned that the work activity on these valves poses a hazard to employees.

5.1.3.2 Employee Effectiveness

The effectiveness of employees performing this work activity is degraded due to (a) the existence of work hazards, and (b) the implication that management is not concerned with the existence of these hazards.

5.1.3.3 Technical Adequacy

Although the design process contributed to the existing problem, since a known design solution has been formulated, technical adequacy is not questioned.

5.2 Main Steam Lines Issues

5.2.1 Management Effectiveness

Management was responsible for the decision to locate work stations near main steam lines within the plants. While this decision was largely unavoidable, they failed to fully consider the emotional aspect of working near such large steam lines. This issue could have been largely avoided by showing employees facts concerning the safety of such steam lines.

5.2.2 Employee Effectiveness

No significant collective significance was assigned.

5.2.3 Technical Adequacy

No collective significance assigned.

5.3 Carbon Dioxide Fire Protection System Issues

5.3.1 Management Effectiveness

Management has been effective in finding and pursuing the correction of known problems with the existing system.

5.3.2 Employee Effectiveness

The effectiveness of employees working in CO_2-protected plant areas is reduced due to fears associated with both a CO_2 discharge, accidental or otherwise, and with the potential for death such a discharge poses.

5.3.3 Technical Adequacy

Due to the perceived dangers associated with this system, and to the fact that accidental discharges have occurred, the technical adequacy of CO_2 fire protection systems for inhabited areas is questionable.

5.4 Collective Significance - Subcategory Level

The collective significance of this subcategory has implications at other ONP sites.

5.4.1 Management Effectiveness

Management has been effective in correcting and mitigating hazards associated with working in confining and crowded areas and in dealing with problems associated with CO_2.

Management has been less effective in communicating with employees. The main steam line issue reveals that employees were never informed that such lines pose no extraordinary threat.

The issue concerning the BFN main steam relief valves, however, is clearly the result of ineffective management. Management has failed to provide sufficient attention to the obvious industrial safety implications associated with the current MSRV removal procedure.

5.4.2 Employee Effectiveness

Cramped and crowded areas within the plant, whether resulting wholly or in part from the design process, impact employee effectiveness. Concern over working within CO_2-protected areas also reduces employee effectiveness.

5.4.3 Technical Adequacy

The current design process, as opposed to that which existed at the time WBN, SQN, and BFN were designed, now includes the review of personnel access as a formal step. The other issues contained within this subcategory reveal no significant technical adequacy problems.

6.0 CAUSES

6.1 Generic

The conditions causing the issues of this subcategory resulted from at least 15 years of design life of SQN and WBN. Management practices and procedures have also caused or failed to correct some of the conditions.

6.2 Site Specific - Watts Bar and Sequoyah

6.2.1 Access Issues

The following is a discussion of the perceived causes assigned to each access-related issue.

Personnel Access Issues

Some of the issues were caused in part by the design process in place when WBN and SQN were designed. This process did not adequately address personnel access as a design consideration. However, the majority of the issues were caused by the continual addition of redundant systems, pipe supports, and seismic supports and bracing which were beyond the control of design. Personnel access was not as important a consideration as was nuclear safety and plant operational characteristics.

The procedure for checking for interferences was primarily the "squad check" procedure. This procedure allowed a designer to route his design through other designers as a means of avoiding complications. As a result, no one was directly responsible for finding and correcting access problems.

There were a number of times when the completion of a design was rushed by the plant construction schedule. When access problems were discovered it was often too late or too costly to correct the problem.

6.2.2 Purge Air Valve Issue

This issue was caused by inadequate personnel access consideration by the design process. A lack of specific knowledge as to how and when the valve operates also contributed to the problem.

6.2.3 Main Steam Line Issue

The issue concerning steam lines resulted from TVA's decision to adopt the "power block" concept of security. Plant design dictated that the security portal be placed near the main steam lines in its present location.

This issue also resulted from a lack of communication about the relative safety of such steam lines, counter balanced by employee awareness that steam line breaks have occurred in power generation plants.

6.2.4 Carbon Dioxide Fire Protection Issue

The issues concerning CO_2 fire protection resulted from TVA's decision to use these systems at its nuclear plants. The concern on the part of employees about the danger of CO_2 as a fire suppressant arose because of a knowledge of accidents that have happened and the changing social acceptability of this method of fire protection.

6.3 Site Specific - Brown's Ferry

6.3.1 Brown's Ferry Main Steam Relief Valve Issue

This issue was caused initially by inadequate consideration about access by the design process. The primary cause, however, is the lack of action by TVA to correct a known, potentially dangerous work process.

7.0 CORRECTIVE ACTIONS

No immediate corrective actions or stop-work orders were initiated as a direct result of this subcategory evaluation. No outstanding corrective actions exists as a result of any prior investigation of the employee concerns addressed by this subcategory report.

Although inadequate consideration was given to personnel access considerations by the design process for WBN, BFN, and SQN, this process has been revised to require formal consideration of personnel access. Office of Engineering Procedure OEP-6 (currently NEP 3.2), as issued in 1985, contains line item check lists that include access as a design input.

Inadequate communication between line management and employees concerning industrial safety issues is addressed by Corrective Action Tracking Documents (CATDs) within subcategories of the Industrial Safety Category as follows:

A. Subcategory Report 90100, Management of Safety.

CATD 90100-1, 5, 9 and 13 establish a Central Safety Committee (CSC) comprised of line management. CATD 90100-2, 6, 10 and 14 establish various line management subcommittees to the CSC. CATD 90100-3, 7, 11 and 15 establish a safety audit program. One of the principle purposes of the CSC will be to communicate and to improve the enforcement of the industrial safety program by all line managers to the employees.

B. Subcategory Report 90500, Life Safety

CATD 90500-1 establishes a periodic safety bullentin to all employees to inform them of site procedures, instructions, and work practices involving work in confined or hazardous plant areas.

The following is a listing of a problem identified in a CATD.

7.1 Site Specific - Browns Ferry

Problem description: The personnel safety hazards associated with main steam relief valve removal and reinstallation in the drywell area have been widely known by plant employees and management since at least August of 1979. BFN-DCR-1879 was issued to improve the safety of this operation. The implementation of this DCR has been postponed several times. Intermediate measures taken to safely perform this job are largely unknown to those presently doing the work.

Corrective Action Plan (CATD 90700-1):

Due to the addition of additional support steel, pipe supports, tail pipes, and other equipment within the drywell area since the issue of DCR-1879, plant management feels that the monorail addition may no longer be technically feasible. BFN plant management will throughly re-evaluate the present work practices for the removal and reinstallation of the main steam relief valves before its next occurrence to insure that their job safety analysis covers extensive prejob planning which include the proper equipment and tools to perform this job safely.

8.0 LIST OF EVALUATORS

J. E. Boyles
G. E. Bruce
D. H. Petree

G. E. Bruce was the principal evaluator of this subcategory. Mr. Boyles and Mr. Petree assisted in limited aspects of the evaluation.

9.0 ATTACHMENTS

"Attachment A - Subcategory Summary Table"

EFERENCE - ECPS131J-ECPS131C
REQUENCY - REQUEST
NP - ISSS - RWM

TEGORY: SF INDUSTRIAL SAFETY

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)
EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY
SUBCATEGORY: 907 DESIGN

1 REPORT APPL
2 SAF RELATED
3 FIND CLASS BF BL SQ WB

CONCERN NUMBER	CAT	SUB CAT	SHR D	PLT LOC	1 REPORT APPL / 2 SAF RELATED / 3 FIND CLASS (BF BL SQ WB)	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTION CAT - SF SUBCAT - 907
AC-85-003	01	SF	907	N SQN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C		OECP	CO2 HAZARD IN THE CONTROL BUILDING O N ELEVATION 669 IN THE COMPUTER AND AUXILIARY INSTRUMENT ROOMS ENDANGERS EMPLOYEES.	1.3, 2.1, 2. 2.5.3, 3.3, 4.3, 5.3, 5. 6.2
X -85-022-00101 T50073		SF	907	N WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C		QTC	THE COMPUTER ROOMS, LOCATED IN CONTR OL BUILDING, ELEV. 708', ARE FIRE PR OTECTED WITH CO2 (CARBON DIOXIDE). THE ELEVATION BELOW THE COMPUTER ROO MS HAS, IN C/I'S OPINION, INADEQUATE (INSUFFICIENT AMOUNT) OF BREATHING E IN THE COMPUTER ROOMS. NO FOLLOW-UP REQUIRED.	1.3, 2.1, 2. 2.4, 2.5.3, 4.3, 5.3, 5. 6.2
-85-431-SQN	01	SF	907	N SQN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B		NSRS	AN UNIDENTIFIED EMPLOYEE FROM SQN CA LLED NSRS TO REPORT TWO CONCERNS DEA LING WITH THE SAME GENERAL AREA.1. PERSONNEL PORTALS USED TO ENTER INTO THE POWER BLOCK SECURITY AREA ARE L OCATED UNDER THE MAIN STEAM LINES OF INE RUPTURE, THERE WOULD BE A GREAT POTENTIAL THAT MANY PEOPLE (50-75) B E SCALDED TO DEATH. 2. A CARD KEY CO NTROLLED PASSAGE BETWEEN THE 706 TU RBINE BUILDING AND CABLE SPREADING R OOM IS IN CLOSE PROXIMITY OF THE MAI N TURBINE OIL TANK. AN ACCIDENT	1.2, 2.1, 2.3.2, 2.4.2 2.5.2, 3.2, 4.2.1.1, 4.2.1.2, 4.2 5.2, 6.2.3

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)
EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY
SUBCATEGORY: 907 DESIGN

CONCERN NUMBER	CAT	SUB CAT	S H R D	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTION CAT - SF SUBCAT - 907
N -85-098-00101 T50010	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA C	IN-85-098-001	QTC	PERSONAL SAFETY OF MAINTENANCE CREW. THERE WAS NOT ENOUGH CONCERN SHOWN BY DESIGN TOWARDS MAINTAINING THIS PLANT. AREAS THAT ARE POTENTIALLY H OT ARE TIGHT, OVER-CROWDED & HARD TO CRAWL THROUGH, PARTICULARLY ANNULUS A HAZARDOUS CONDITION FOR MAINTENANC E PEOPLE.	1.1, 2.1, 2. 2.4.1, 2.5.1 3.1.1, 4.1.1 5.1.1, 5.4, 6.2.1
N -85-133-00101 T50004	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B		QTC	THE LOCATION OF THE SECONDARY CHEM L AB AND ACCESS CONTROL PORTAL ARE IMM EDIATELY NEXT TO MAIN STEAM LINES. IF THESE PIPES WERE TO RUPTURE, LOSS OF LIFE AND SECURITY COULD OCCUR AS THE FACILITY IS MANNED 24 HRS/DAY. TACT REQUIRED	1.2, 2.1, 2. 2.4, 2.5.2, 4.2, 4.2.1.1 4.2.1.2, 4.2 5.2, 6.2.3
N -85-189-00301 T50089	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA B	IN-85-189-003	QTC	IN UNIT #2 ANNULUS AREA, THE PERMANE NT LADDERS ARE SPACED TOO FAR APART. AN INDIVIDUAL ON ONE ELEVATION WOU LD HAVE TO WALK 1/2 WAY AROUND BUILD ING (180 DEGREES) TO GET TO LADDER T O CLIMB TO THE NEXT ELEVATION. CI C ILS.	1.1, 1.1.1, 2.3.1, 2.4.1 2.5.1, 3.1.1 4.1.1, 5.1.1 5.4, 6.2.1

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)
EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY

TEGORY: SF INDUSTRIAL SAFETY
SUBCATEGORY: 907 DESIGN

CONCERN NUMBER	CAT	SUB CAT	SHRD	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTION CAT - SF SUBCAT - 907
N -85-191-00301 T50072	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B		QTC	MAIN STEAM LINES FORM REACTOR TO TURBINE BUILDING ARE GOING OVER THE SECURITY PORTAL. IF ONE OF THEM BREAKS, IT WOULD HIT THE PORTAL. PEOPLE ARE WORKING 24 HOURS A DAY. LOSS OF LIFE AND SECURITY COULD OCCUR.	1.2, 2.1, 2.2.4.2, 2.5.2 3.2, 4.2, 4.2.1.1, 4.2.2.2, 4.2 5.2, 6.2.3
N -85-267-00101 T50032	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B		QTC	ACCESS PORTAL TOO CLOSE TO HIGH TEMPERATURE/HIGH PRESSURE PIPES.	1.2, 2.1, 2.2.4.2, 2.5.2 3.2, 4.2, 5.2.1.1, 4.2.1.1, 4.2 5.2, 6.2.3
N -85-463-00201 T50036	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA B		QTC	UNIT #2- REACTOR #2, 724' OR 737' ELEVATION TVA IDENTIFIER 2-FCV-30-54, PURGE AIR VALVE, INSTALLED IN A CONGESTED AREA, BLOCKS WALKWAY AND POSES A PERSONAL SAFETY HAZARD IN THAT WHEN THE VALVE IS OPERATING THE BODY S PASSABLE.	1.1, 2.1, 2.2.4.1, 2.5.1 3.1.2, 4.1.2 5.1.2, 6.2.2

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)

EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY

TEGORY: SF INDUSTRIAL SAFETY
SUBCATEGORY: 907 DESIGN

CONCERN NUMBER	CAT	SUB CAT	S H R D	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTION CAT - SF SUBCAT - 907
N -85-746-00101 T50072	OP	305	S	WBN	1 2 3	IN-85-746-001	QTC	EXCESSIVE AND UNNECESSARY SUPPORT BR ACING INSTALLED IN AREAS WHICH PRODU CE A SAFETY HAZARD FOR PERSONNEL WHO MUST ENTER TO WORK IN THESE AREAS. EXAMPLES: #4 ACCUMULATOR ROOM, BIT TANK ROOM, ANNULUS AREA, MOTOR DRIV D VALVES CANNOT BE REACHED IN ADDITI ON, AN INJURED PERSON COULD NOT BE E VACUATED.	1.1, 2.1, 2. 2.4.1, 2.5.1 3.1.1, 4.1.1 5.1.1, 5.4, 6.2.1,
02	SF	907	S	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA C				
03	SF	908	S	WBN	2 NA NA NA NO 3 NA NA NA E				
N -85-841-00201 T50084	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA B	IN-85-841-002	QTC	DUE TO NUMBER AND SIZE OF HANGERS WH ICH HAVE BEEN INSTALLED IN UNIT 1, A CCESS AND MAINTENANCE TO PLANT EQUIP MENT (GENERIC) IS DIFFICULT, AND WAS EXPRESSED AS POTENTIALLY COMPROMISI NG TO PERSONNEL SAFETY IN SOME INSTA	1.1, 2.1, 2. 2.4.1, 2.5.1 3.1.1, 4.1.1 5.1.1, 5.4, 6.2.1
N -85-861-00201 T50087	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA B	IN-85-861-002	QTC	PERSONNEL ACCESS TO ACCUMULATOR ROOM #4 IS MADE UNSAFE AND DIFFICULT BY THE AMOUNT OF CONGESTION AND THE HIG H TEMPERATURE OF PIPES FROM MANY DIF FERENT SYSTEMS THAT RUN THROUGH THE AREA. (UNIT 2, ELEV 729' APPROX AZ ACCUMULATOR VESSEL)	1.1, 2.1, 2. 2.4.1, 2.5.1 3.1.1, 4.1.1 5.1.1, 5.4, 6.2.1

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)

EGORY: SF INDUSTRIAL SAFETY

EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY
SUBCATEGORY: 907 DESIGN

CONCERN NUMBER	CAT	SUB CAT	S H R D	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTIO CAT - SF SUBCAT - 90
N -85-892-00101 T50094	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C	IN-85-892-001	QTC	CI STATES THAT THE WINTERGREEN ODOR WAS REMOVED FROM THE CO2 IN THE FIRE PROTECTION SYSTEMS IN THE CONTROL BUILDING. CI CLAIMS THAT DETECTION EQUIPMENT IS NOT REQUIRED TO DETECT THE PRESENCE OF CO2 CI WOULD LIKE TO INTO THE CO2 FOR PERSONNEL PROTECTION. NO FURTHER DETAILS AVAILABLE. NO FOLLOW UP REQUIRED.	1.3, 2.1, 2. 2.4, 2.5.3, 4.3, 5.4, 5. 6.2
N -85-906-00101 T50093	SF	907	N	WBN	1 N N N Y 2 NA NA NA NO 3 NA NA NA B	IN-85-906-001	QTC	THE REACTOR BUILDING ACCUMALATOR AREAS ARE VERY CONGESTED. THIS CONGESTION WILL PROBABLY CAUSE INJURIES/BURNS DURING NORMAL PLANT OPERATIONS. CI HAS NO FURTHER DETAILS. NO FOLLOW UP REQUIRED.	1.1, 2.1, 2 2.4.1, 2.5. 3.1.1, 4.1. 5.1.1, 5.4, 6.2.1
N -85-918-00301 T50137	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C		QTC	PERSONNEL SAFETY ENDANGERED BY COZ SYSTEM IN DIESEL GENERATOR BLDG. #1: WARNING LIGHTS NOT VISIBLE FROM MOST OF THE AREA, WARNING ALARM NOT AUDIBLE WHILE ENGINES ARE RUNNING. PERSONNEL RISK ASPHYXIATION IF SYSTEM DIO CHANGE SYSTEM OUT (AS IN NEW DIES. GEN. BLDG. & CONTROL BLDG. CONSTRUCTION DEPT. CONCERN. CI HAS NO MORE INFORMATION. NO FURTHER FOLLOW-UP REQUIRED.	1.3, 2.1, 2 2.4, 2.5.3, 3.3, 4.3, 5 5.4, 6.2

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TEGORY: SF INDUSTRIAL SAFETY

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)
EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY
SUBCATEGORY: 907 DESIGN

CONCERN NUMBER	CAT	SUB CAT	SHR D	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTIO CAT - SF SUBCAT - 90
N -86-048-00101 T50114	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C	IN-86-048-001	QTC	THERE IS NO WAY OF KNOWING IF CO2 IS DUMPED, IF ALARM SYSTEM AND CO2 MONITORS IN CENTRAL ALARM STATION FAIL. THE SYSTEM FAILED ABOUT 3 MONTHS AGO. CI HAS NO FURTHER INFORMATION. NUC POWER CONCERN.	1.3, 2.1, 2. 2.4, 2.5.3, 3.3, 4.3, 5. 5.4, 6.2
N -86-101-00201 T50119	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B	IN-86-101-002	QTC	IN THE TURBINE BUILDING PORTAL AREA 708' ELEVATION (WHERE KEY-CARD BADGES ARE PICKED UP) A STEAM LINE RUNS THROUGH THE AREA AND COULD CAUSE A PERSONNEL HAZARD. CI HAS NO ADDITIONAL INFORMATION. NUC PWR CONCERN/PSS	1.2, 2.1, 2. 2.4.2, 2.5.2 3.2, 4.2, 4. 4.2.1.2, 4.2 5.2, 6.2.3
N -86-137-00101 T50127	SF	907	N	WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B	IN-86-137-001	QTC	VITAL AREA ACCESS PORTALS IN THE TURBINE BLDG, ELEV. 708' AND DOORS 100 & 106 IN THE "YARD" BEWEEN THE DIESEL BLDG & AUX BLDG ARE IN CLOSE PROXIMITY OF 24" OR 36" O (BEST GUESS) STEAM LINES. IN THE EVENT OF A RUPTUR ICINITY WOULD BE SEVERELY INJURED. NUC POWER CONCERN. CI HAS NO ADDITIONAL INFORMATION.	1.2, 2.1, 2. 2.4.2, 2.5.2 3.2, 4.2, 4.2.1.1, 4.2.1.2, 4.2 5.2, 6.2

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

CONCERN NUMBER	CAT	SUB CAT	SHR D	PLT LOC	1 REPORT APPL 2 SAF RELATED 3 FIND CLASS BF BL SQ WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTION CAT - SF SUBCAT - 907
MM-85-004	01	SF	907	N SQN	1 N N Y Y 2 NA NA NO NO 3 NA NA B B		OECP	WHAT DOES CO2 HORN SOUND LIKE?	1.3, 2.1, 2. 2.4, 2.5.3, 4.3, 5.3, 5. 6.2.4
BN-0299	01	SF	907	N WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C		OECP	PERSONNEL DOWN STAIRS IN THE D/G BUI LDING CANNOT HEAR THE CO2 ALARM FOR THE UPSTAIRS BOARD ROOMS.	1.3, 2.1, 2. 2.4, 2.5.3, 4.3, 5.3, 5. 6.2
BN-241	01	SF	907	N WBN	1 N N Y Y 2 NA NA NO NO 3 NA NA C C		OECP	THE CURRENT POLICY IS THAT MAINTENAN CE WORK CAN AND WILL BE DONE IN THE DIESEL GENERATOR BUILDING WITH THE C O2 SYSTEM IN AUTOMATIC. THE DGB MAI NTENANCE WORK IS DIFFERENT THAN MAIN TENANCE WORK IN SOME CO2 PROTECTED A OP OF DIESEL AND WHEN THE CO2 ALARM GOES OFF THE MAINTENANCE WORKERS ARE APT TO FALL AND INJURE THEMSELVES T RYING TO GET OUT OF THE AREA BEFORE CO2 IS DUMPED. AN ALTERNATE IS TO V ALVE OUT THE CO2 AND POST A FIRE WAT CH DURING MAINTENANCE ACTIVITY.	1.3, 2.1, 2. 2.4, 2.5.3, 4.3, 5.3, 5. 6.2.4

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

TENNESSEE VALLEY AUTHORITY
OFFICE OF NUCLEAR POWER
EMPLOYEE CONCERN PROGRAM SYSTEM (ECPS)
EMPLOYEE CONCERN INFORMATION BY CATEGORY/SUBCATEGORY

TEGORY: SF INDUSTRIAL SAFETY
SUBCATEGORY: 907 DESIGN

1 REPORT APPL
2 SAF RELATED
3 FIND CLASS

CONCERN NUMBER	CAT	SUB CAT	S H R D	PLT LOC	BF	BL	SQ	WB	HISTORICAL REPORT	CONCERN ORIGIN	CONCERN DESCRIPTION	REF. SECTIO CAT - SF SUBCAT - 90
X -85-004-00101 T50096	SF	907	N	SQN	1 N 2 NA 3 NA	N NA NA	Y NO B	Y NO B	XX-85-004-001	QTC	PERSONNEL SAFETY: NON-NUCLEAR, SEQUOYAH LOCATION OF SECONDARY CHEM. LAB AND ACCESS CONTROL PORTAL IS IMMEDIATELY NEXT TO MAIN STEAM LINES IN THE TURBINE BUILDING. IF THESE PARTICULAR PIPES RUPTURED, LOSS OF LIFE AN FACILITIES ARE MANNED 24 HOURS A DAY. UNITS 1 & 2. THE SECURITY AREA CONTAINS AMMUNITION AND THE LAB CONTAINS TOXIC CHEMICALS.	1.2, 2.1, 2. 2.4.2, 2.5.2 3.2, 4.2, 4.2.1.1, 4.2.1.2, 4.2 5.2, 6.2.3
X -85-106-00101 T50176	SF	907	N	BFN	1 Y 2 NO 3 D	N NA NA	N NA NA	N NA NA		QTC	BROWNS FERRY: THE METHOD USED FOR PULLING THE MAIN STEAM RELIEF VALVES IS INADEQUATE AND POSES AN INDUSTRIAL SAFETY HAZARD. THERE IS NO SYSTEM FOR BRINGING THE VALVES OUT EXCEPT USING CHAIN (FALLS?) AND PULLING SI HE CHAIN FALLS HAVE BROKEN IN THE PAST AND AT LEAST ONE MINOR INJURY HAS OCCURRED. THIS CONDITION HAS BEEN REPORTED TO TVA MANAGEMENT ON NUMEROUS OCCASIONS. NUCLEAR POWER CONCERN. CI HAS NO FURTHER INFORMATION. NO FOLLOW UP REQUIRED.	1.2.3, 2.1, 2.3.1, 2.4.1 2.5.1, 3.1.3 4.1.3, 5.1.3 6.1.3

23 CONCERNS FOR CATEGORY SF SUBCATEGORY 907

CONCERNS ARE GROUPED BY FIRST 3 DIGITS OF SUBCATEGORY NUMBER.

ECTG C.3
Attachment A
Page 1 of 1
Revision 2 - A

ECSP Corrective Action Tracking Document (CATD)

INITIATION — **Applicable ECSP Report NO:**

1. Immediate Corrective Action Required: ☐ Yes ☐ No
2. Stop Work Recommended: ☐ Yes ☐ No
3. CATD No. 90700-1 4. INITIATION DATE 8-19-86
5. RESPONSIBLE ORGANIZATION: Browns Ferry Nuclear Plant ONP Site
6. PROBLEM DESCRIPTION: ☐ QR ☐ NQR The personnel safety hazards associated with main steam relief valve removal and re-installation in the drywell area has been widely known by plant employees and management since at least August of 1979. BFN-DCR-1879 was issued to improve the safety of this operation. The implementation of this DCR has been postponed several times. Intermediate measures taken to safely perform this job are largely unknown to those presently doing the work.

☐ ATTACHMENTS

7. PREPARED BY: NAME Gaines E. Bruce DATE: 8-19-86
8. CONCURRENCE: CEG-H DATE: 8/21/86
9. APPROVAL: ECTG PROGRAM MGR. DATE: 8/21/86

CORRECTIVE ACTION

10. PROPOSED CORRECTIVE ACTION PLAN: See attached sheet

☑ ATTACHMENTS

11. PROPOSED BY: DIRECTOR/MGR: SHRudge for H.P.Pomrehn DATE: 8/25/86
12. CONCURRENCE: CEG-H: DATE:
SRP: DATE:
DATE:
DATE:
DATE:
ECTG PROGRAM MGR: DATE:

VERIFICATION AND CLOSEOUT

13. Approved corrective actions have been verified as satisfactorily implemented.

SIGNATURE | TITLE | DATE