DOCUMENT CONTROL COVER SHEET

TITLE Midland Independent Design and Construction Verification Program Control Room HVAC System Performance Requirements

CONT. I.D. NO. 3201-002-R-004

PROJECT Midland Independent Design and Construction Verification Program

NO. OF SHTS.

SUPERSEDES DOCUMENT NO.

REV. NO.	REVISION	ORIGINATOR	DATE	REVIEWED BY	DATE	APPROVED BY	DATE
0	Original Issue		7/18/84		7/18/84		7/18/84

SUBJECT

Draft Interim Technical (Topical) Report on the Control Room Heating, Ventilating, and Air Conditioning (CR-HVAC) System Performance Requirements

PURPOSE

This draft report has been prepared within the Independent Design Verification Program (IDVP) of the Midland Independent Design and Construction Verification Program (IDCVP) as partial fulfillment of IDCVP objectives. The report documents the IDVP review process and conclusions related to the adequacy of the design of the control room HVAC (CR-HVAC) System Performance Requirements as defined in the Midland IDCVP Engineering Program Plan (PI-3201-009 of the Project Quality Assurance Plan). Upon receipt of CPC and NRC comments to clarify factual information, the draft report will be finalized and will serve as input into the IDCVP integrated assessment and final report preparation.

SOURCES of INFORMATION and REFERENCES

As noted on table, "References/Sources of Information" (Attachment B of PI-3201-001, Rev. 2), of Engineering Evaluations PI-3201-061, -062, -063, -065, -066, -067, -068 and -069.

(May Be Continued On A Separate Sheet)

MIDLAND ENERGY CENTER

INDEPENDENT DESIGN AND CONSTRUCTION VERIFICATION PROGRAM

CONTROL ROOM HVAC SYSTEM PERFORMANCE REQUIREMENTS

July 18, 1984

B-84-148

TERA CORPORATION

TABLE OF CONTENTS

TABLE OF CONTENTS

(CONTINUED)

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE

Abbreviation	Term
ACGIH	American Conference and Governmental Industrial Hygienists Handbook
AFW system	auxiliary feedwater system
ASHRAE	American Society of Heating, Refrigeration and Air-conditioning Engineers
B&W	Babcock and Wilcox
BOP	balance of plant
CFR	Code of Federal Regulations
CPC	Consumers Power Company
CRAVS	control room area ventilation system
CR-HVAC	control room heating, ventilating, and air conditioning
CRIS	control room isolation system
EPP	Engineering Program Plan
ESFAS	engineered safety features actuation system
FSAR	Final Safety Analysis Report
GDC	General Design Criteria
HEPA	high efficiency particulate air
HGMS	hazardous gas monitoring system
ICVP	Independent Construction Verification Program
IDCVP	Independent Design and Construction Verification Program
IDVP	Independent Design Verification Program
IEEE	Institute of Electrical and Electronics Engineers
LOCA	loss of coolant accident
MCAR	Management Correction Action Reports
NDE	nondestructive examination
NRC	Nuclear Regulatory Commission
OCR	Open, Confirmed and Resolved Item Reports
P&ID	piping and instrument diagrams
PQAP	Project Quality Assurance Plan
PRA	probabilistic risk assessment
QA	quality assurance
QAP	Quality Assurance Program
RG	Regulatory Guide
SCRE	Safety, Concern, and Reportability Evaluation
SEP system	standby electric power system
SRP	Standard Review Plan

PREAMBLE

This topical report is part of a series of reports that will document the Midland Independent Design and Construction Verification Program (IDCVP) review process and conclusions. Verification activities are ongoing and this report represents partial fulfillment of the objectives of the IDCVP. An integrated assessment will follow which will combine the specific topical report reviews into general conclusions, considering both the specific and potentially broader implications of documented Findings.

TERA Corporation has not reviewed all aspects of the Midland Energy Center design or construction as the approach selected relies upon sampling. The IDCVP methodology has been structured to provide increased confidence that safety-significant deficiencies are detected within the scope of review. Other verification programs provide oversight of essentially all elements of the Midland project completion cycle. Accordingly, the complete set of programs and the NRC regulatory program are collectively directed to verify that the Midland plant has been designed and constructed in conformance with NRC regulations.

1.0 EXECUTIVE SUMMARY

The Control Room Heating, Ventilating, and Air Conditioning (CR-HVAC) System Performance Requirements Report is the second of six topical reports that document the Midland Independent Design Verification Program (IDVP). The report describes the review process and results of the review related to the primary functional requirements such as operating limits, pneumatic design, filtration, and instrumentation and control.

The review process followed the requirements set forth in the Project Quality Assurance Plan (PQAP) and Engineering Program Plan (EPP) that had been previously accepted by the NRC staff. This review process sampled the design adequacy using a set of important design topics, each representing typical engineering design areas. Each topic was, in turn, reviewed to levels of detail appropriate for verifying a comprehensive sample of CR-HVAC system design activities.

No Findings were identified during this review. Confirmed Items (i.e., apparent design errors) that were noted during execution of the IDVP were resolved after further review. The potential generic implications of these items were evaluated collectively with noted Observations. Observations are minor discrepancies, such as mathematical, transposition, or referencing errors in calculations that do not obviously affect quality of the design product or constitute design errors.

Based on the collective evaluation of Confirmed Items and Observations one concern remains: the concern regarding the nature and extent of calculational errors.

This concern and a second generic issue, the lack of centralized design criteria documents, were noted in the previously completed Auxiliary Feedwater (AFW) System Performance Requirements Report. Although no centralized design criteria other than the Final Safety Analysis Report (FSAR) existed for the CR-HVAC, the implications were not as significant as those in the AFW review.

Further evaluation is required in subsequent phases of the review to resolve these two items. Verification activities are ongoing, and conclusions will be documented in the future report on the IDVP Integrated Assessment. These activities are focused on a determination of whether the two issues could result in safety-significant deficiencies in other areas of the Midland plant design.

Based upon the Independent Design and Construction Verification Program (IDCVP) review and independent confirmatory evaluations, it is concluded that confidence exists that the CR-HVAC system has met its design requirements and will perform its intended safety function.

2.0 INTRODUCTION

2.1 SUMMARY

The Control Room Heating, Ventilating and Air Conditioning System (CR-HVAC) Performance Requirements Report is the second of six topical reports that document the Midland Independent Design Verification Program (IDVP). The first report covered the auxiliary feedwater (AFW) system. This report describes the review process and results of the review related to CR-HVAC system performance requirements such as operating limits, pneumatic design, filtration, and instrumentation and control design. Future reports will be issued to address similar system performance requirements for the standby electric power (SEP) system, review topics associated with system protection features and structures housing the systems that are generic to all three systems. A final report will provide an integrated assessment of the IDVP results. A subsequent set of reports will address the Midland Independent Construction Verification Program (ICVP).

The IDVP review process followed the requirements set forth in the Project Quality Assurance Plan (PQAP) and Engineering Program Plan (EPP) that had been previously accepted by the Nuclear Regulatory Commission (NRC) staff. This review process sampled the design adequacy using a set of important design topics, each representing typical engineering design areas. Each topic was, in turn, reviewed to levels of detail appropriate for verifying a comprehensive sample of the CR-HVAC system design activities.

Design criteria and commitments for the CR-HVAC system were systematically reviewed and compiled for all safety-related design activities associated with the CR-HVAC system.

A Consolidated Criteria and Commitments List was prepared by the IDVP and was used in the evaluation of selected design activities. These evaluations were directed into specific design topics and resulted in identification of design concerns in the form of Open Items, Observations, and Confirmed Items. Open

Items are concerns requiring additional review; Observations are minor discrepancies not constituting design errors but needing correction or further review by the Midland Project; Confirmed Items are apparent design errors. There were no Findings, i.e., verified design errors.

The IDVP review methodology and scope for the CR-HVAC System Performance Requirements report parallels the review for the AFW system which has been documented in an earlier Independent Design and Construction Verification Program (IDCVP) report. Reference should be made to Appendix A of the AFW System Performance Requirements report for a detailed discussion of the review methodology.

Figure 2-1 shows the interrelationship between the design and construction process and corresponding categories of review within the IDCVP scope. When these categories of review are combined with a listing of design/construction topics, a matrix is formed which is used to provide direction for the IDCVP. A key element in the conduct of the CR-HVAC system evaluation is the IDVP sample review matrix. The IDVP sample review matrix is divided into three major divisions: System Performance Requirements, System Protection Features, and Structures that House the System (see Figures 2-2 and 2-3). The development of the design review matrix and the scope addressed by this report as well as the interface between the IDVP for the CR-HVAC system and the ICVP are presented in Section 3.0.

The scope of this report addresses the system performance requirements for the CR-HVAC system. System performance requirements include elements of the design specifically related to how the primary functional requirements such as system operating limits, pneumatic design, filtration, and instrumentation and control are met.

2.2 APPROACH TO VERIFICATION

The sample review matrix for the CR-HVAC system consists of five categories of review, which are discussed in detail in Appendix A of the AFW System

INTER-RELATIONSHIP BETWEEN THE MIDLAND DESIGN AND CONSTRUCTION PROCESS AND THE MIDLAND IDCV PROGRAM

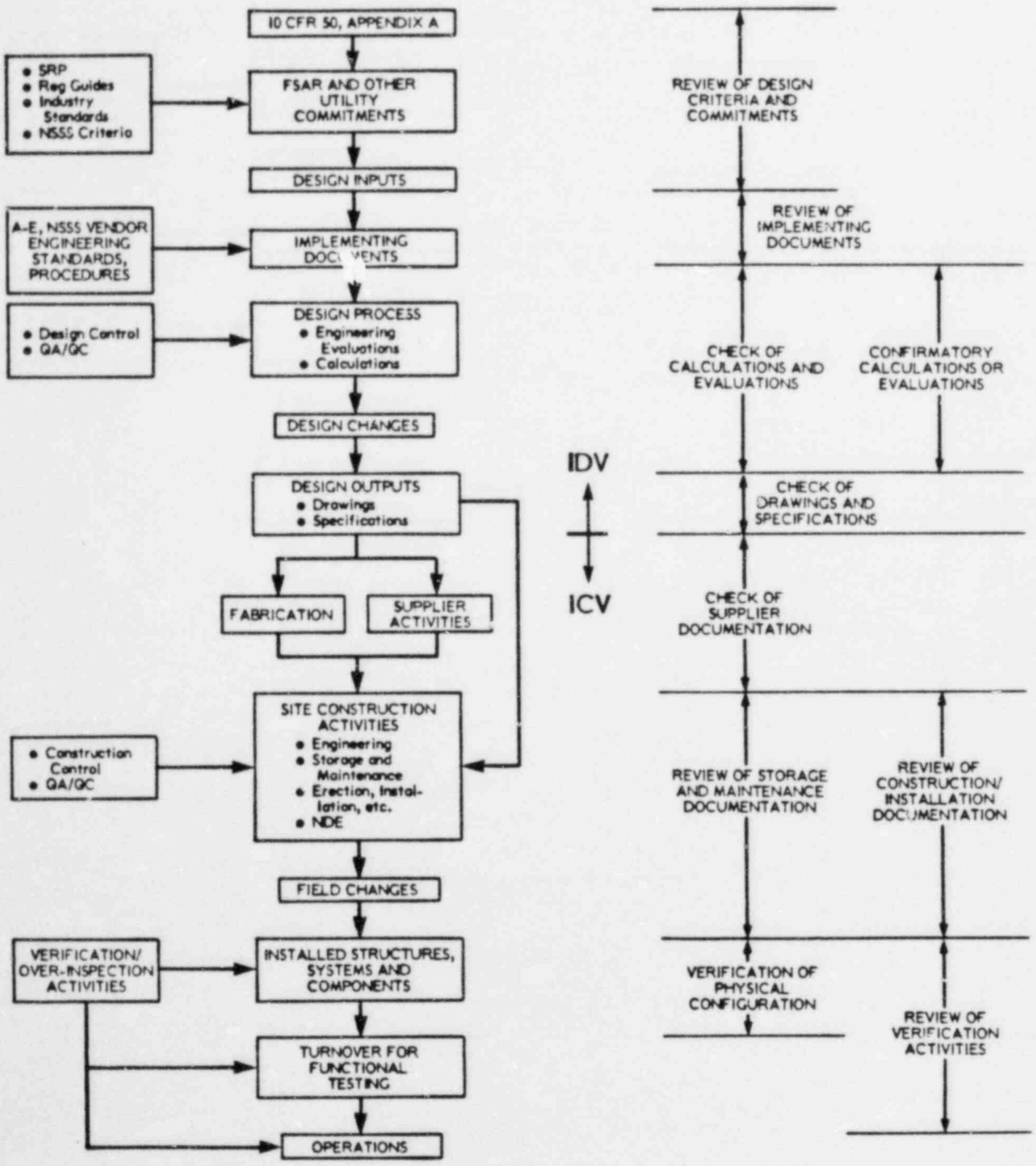

FIGURE 2-1

INTER-RELATIONSHIP BETWEEN THE MIDLAND DESIGN AND CONSTRUCTION PROCESS AND THE MIDLAND IDCV PROGRAM

INITIAL SAMPLE REVIEW MATRIX FOR THE CONTROL ROOM HVAC SYSTEM
MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM

TOPIC NUMBER	DESIGN AREA	SCOPE OF REVIEW: REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
	CONTROL ROOM HVAC SYSTEM PERFORMANCE REQUIREMENTS					
1.1-3	SYSTEM OPERATING LIMITS	X	X	X		
1.2-3	ACCIDENT ANALYSIS CONSIDERATIONS	X	X			
1.3-3	SINGLE FAILURE	X	X	X		
1.4-3	TECHNICAL SPECIFICATIONS	X	X			
1.5-3	SYSTEM ALIGNMENT/SWITCHOVER	X	X			
1.7-3	SYSTEM ISOLATION/INTERLOCKS	X	X	X		X
1.9-3	COMPONENT FUNCTIONAL REQUIREMENTS	X	X	X		X
1.10-3	SYSTEM PNEUMATIC DESIGN	X	X	X	X	X
1.12-3	COOLING/HEATING REQUIREMENTS	X	X	X		
1.14-3	PRESERVICE TESTING/CAPABILITY FOR OPERATIONAL TESTING	X	X			
1.15-3	POWER SUPPLIES	X	X			
1.18-3	INSTRUMENTATION/DETECTION	X	X	X		X
1.19-3	CONTROL SYSTEMS	X	X			X
1.20-3	ACTUATION SYSTEMS	X	X	X		X
1.21-3	NDE COMMITMENTS	X	X	X		
1.22-3	MATERIALS SELECTION	X	X	X		X
1.23-3	FAILURE MODES AND EFFECTS	X	X	X		
1.33-3	FILTRATION	X	X	X		X
1.34-3	PRESSURIZATION	X	X	X		X
1.35-3	VENTILATION	X	X	X	X	X

FIGURE 2-2

INITIAL SAMPLE REVIEW MATRIX FOR THE
CONTROL ROOM HVAC SYSTEM
MIDLAND IDCV PROGRAM

INITIAL SAMPLE REVIEW MATRIX FOR THE CONTROL ROOM HVAC SYSTEM MIDLAND INDEPENDENT DESIGN VERIFICATION PROGRAM (CONTINUED)

TOPIC NUMBER	DESIGN AREA	SCOPE OF REVIEW: REVIEW OF DESIGN CRITERIA AND COMMITMENTS	REVIEW OF IMPLEMENTING DOCUMENTS	CHECK OF CALCULATIONS AND EVALUATIONS	CONFIRMATORY CALCULATION OR EVALUATION	CHECK OF DRAWINGS AND SPECIFICATIONS
	CONTROL ROOM HVAC SYSTEM PROTECTION FEATURES					
II.1-3	SEISMIC DESIGN	X				
II.2-3	• PRESSURE BOUNDARY	X	X	X		
II.3-3	• DUCT/PIPE/EQUIPMENT SUPPORT	X	X	X		X
II.4-3	• EQUIPMENT QUALIFICATION	X	X	X		X
II.5-3	HIGH ENERGY LINE BREAK ACCIDENTS	X				
II.6-3	• PIPE WHIP	X				
II.7-3	• JET IMPINGEMENT	X				
II.8-3	ENVIRONMENTAL PROTECTION	X				
II.9-3	• ENVIRONMENTAL ENVELOPES	X	X	X	X	X
II.10-3	• EQUIPMENT QUALIFICATION	X	X	X		X
II.12-3	FIRE PROTECTION	X	X			
II.13-3	MISSILE PROTECTION	X				
II.14-3	SYSTEMS INTERACTIONS	X				
	STRUCTURES THAT HOUSE THE CONTROL ROOM HVAC SYSTEM					
III.1-3	SEISMIC DESIGN/INPUT TO EQUIPMENT	X	X	X		
III.5-3	CIVIL/STRUCTURAL DESIGN CONSIDERATIONS	X				
III.7-3	• CONCRETE/STEEL DESIGN	X	X			
III.9-3	• LEAK TIGHTNESS	X	X	X		

FIGURE 2-3

INITIAL SAMPLE REVIEW MATRIX FOR THE
CONTROL ROOM HVAC SYSTEM
MIDLAND IDCV PROGRAM
(CONTINUED)

Performance Requirements report. The application of these categories of review to the CR-HVAC system is discussed below.

Review of Design Criteria and Commitments

All of the design areas listed in the matrix were reviewed for design criteria and commitments. The principal sources of criteria and commitments are the FSAR and 10 CFR 50. These documents, related correspondence, and other subtier documentation were reviewed and criteria and commitments applicable to the CR-HVAC system were extracted, listed on topical checklists, and later compiled by the IDVP into a Consolidated Criteria and Commitments List. The Consolidated Criteria and Commitments List is presented in Appendix B to this report. No overall CR-HVAC system design criteria document exists other than the FSAR.

Review of Implementing Documents

For the purposes of this report, the primary implementing documents were the piping and instrument diagrams (P&IDs), the flow diagram, and electrical logic diagrams. These implementing documents were reviewed against the previously evaluated design criteria and commitments. Additionally, where appropriate, the implementing documents were checked for internal consistency and for consistency between the documents. Although the IDVP is not intended as a process (QA) review, the reviews of implementing documents, calculations, etc., made note of quality assurance discrepancies such as a lack of approval signatures.

Check of Calculations and Evaluations

Selected Midland project calculations and evaluations were reviewed using the design criteria, commitments, and implementing documents as standards against which the calculations were verified; e.g., a calculation would be reviewed for consistency with the design criteria. Calculational inputs, which were obtained from implementing documents, and calculational outputs, which appear on imple-

menting documents, were checked to verify that such information was appropriately transferred. Other calculation review considerations include those identified in N45.2.11.

Confirmatory Calculations and Evaluations

In some cases, it was decided to prepare confirmatory calculations or evaluations. The purpose of performing such calculations or evaluations was to provide an independent method for verifying the appropriateness of the results of calculations and evaluations performed in the design process. The person performing the confirmatory calculation or evaluations selected the calculational method of evaluation, certain input data, and assumptions that he considered appropriate. The conclusions reached in performing the confirmatory analyses were then compared against the results obtained in the original design calculations and evaluations.

Confirmatory calculations were performed to determine the effects of locally non-uniform concentrations of toxic gases in the vicinity of the supply ducts in the control room. These pneumatic and ventilation aspects had been simplified in the design calculations and therefore, the confirmatory calculation had the purpose of quantifying the effect of the simplifying assumptions. System heat loads and carbon dioxide buildup under isolated conditions were the subjects of confirmatory calculations.

Check of Drawings and Specifications

Selected drawings and specifications were reviewed in verifying aspects of CR-HVAC system performance requirements. Drawings included HVAC layout, electrical schematics, electrical single-line diagrams, and equipment arrangements. The purchase specifications for air handling units, dampers, filters, and the hazardous gas monitoring system (HGMS) were reviewed. The drawings and specifications were compared against each other to determine the consistency of these documents. They were also reviewed against design criteria, implementing

documents, and calculations, as appropriate, to evaluate the implementation of the output of those steps in the design process for the purchased components.

Knowledge of organization interfaces is important to effective execution of the IDVP to ensure that representative products from principal design organizations are sampled. The major organizational interfaces which affected the CR-HVAC system design were between Bechtel and Consumers Power Company (CPC). No significant interfaces occurred with Babcock & Wilcox (B&W). An example of an area involving a CPC/Bechtel interface which was reviewed was the specification of the HGMS. Bechtel wrote the technical specification for procurement and interfaced with the vendor. CPC contracted with consultants to provide data as indirect input to the specification, and both Bechtel and CPC participated in the interface with Dow which was important to developing the specification.

The scope of the IDCVP has been structured primarily to review the end products of the design process. Consequently, the scope did not specifically focus on an investigation of the processes by which interfaces between design organizations were controlled; however, the effectiveness of these interfaces was tested by the IDVP review. For example, the IDVP reviews whether the outputs of the transmitting organization are properly received and interpreted by the receiving organization. In the process of performing the IDVP end product reviews, if a potential breakdown is identified, appropriate interfaces are examined in greater detail.

This report has been transmitted to the IDCVP Service List providing an opportunity for CPC, NRC, and the public to review its contents. The report will be finalized upon receipt of CPC's comments, which will be appended in unedited form as Appendix A. CPC's review and comments are intended to verify and clarify facts and source data. Any changes to the body of the report resulting from CPC clarification of facts and source data will be identified in the margins of the final report.

3.0 CONTROL ROOM HVAC SYSTEM SELECTION AND DESCRIPTION

3.1 SELECTION OF CR-HVAC SYSTEM

The Nuclear Regulatory Commission (NRC) selected the control room HVAC (CR-HVAC) system and standby electric power (SEP) systems to increase the sample size of the overall Independent Design and Construction Verification Program (IDCVP). The inclusion of the CR-HVAC was considered after the NRC requested that Consumers Power Company (CPC) identify candidate systems for scope expansion based upon the contribution to plant risk as quantified by the Midland plant probabilistic risk assessment (PRA). The selection was compared against the same criteria used by the IDCVP in the selection of the auxiliary feedwater (AFW) system. These criteria are defined in Section 1.3 of the Engineering Program Plan (EPP). The profile against the selection criteria was judged to be high and to improve the IDCVP by extending the sample into other engineering disciplines or construction areas.

Based upon the Midland PRA, control room habitability is sufficiently important to safety to merit inclusion of the CR-HVAC system in the IDCVP. The proximity to the site of the Dow Chemical Company facilities with its large volume of chemicals demonstrates the importance of the system and results in a unique design interface and design consideration involving the hazardous gas monitoring system (HGMS). The interfaces included the complex acquisition of design data from the offsite facilities and a procurement interface in the technology development stage of the monitoring system.

Inclusion of the CR-HVAC significantly enhanced the ability to extrapolate results, because it extended the sample to areas of design that were not of major significance in the other systems. In particular, the implementation of HVAC criteria was performed by Bechtel organizational units which had little role in the AFW design (for example, the group responsible for HVAC mechanical design).

The selection criteria also included consideration of previous experience. Questionable control of the fabrication and installation processes for HVAC components, notably ductwork and supports had been previously observed. This particular criterion is more applicable to the Independent Construction Verification Program (ICVP) and to the design aspects associated with seismic qualification which are both being addressed in subsequent reports.

The last selection consideration is the ability to test as-built installations. Substantially all of the major components for the CR-HVAC are currently installed. Some duct installation remains, but the majority is complete. The HGMS is not complete; however, the critical design aspects were not expected to be influenced in a major way by as-built considerations.

3.2 CR-HVAC SYSTEM INTERFACE WITH OTHER ASPECTS OF THE IDCVP

The CR-HVAC system shares interfaces with the two other systems in the Independent Design Verification Program (IDVP). The SEP system provides the ac and dc power required to operate CR-HVAC components and to allow control of the system. The SEP also supplies essential power to the AFW system. The control room and CR-HVAC are located in the auxiliary building, as are the AFW system and portions of the SEP system. Thus, the CR-HVAC system shares interfaces with both of the other systems within the IDVP.

The existence of these interfaces improved the effectiveness of the IDVP by allowing the review to consider the design interfaces between systems and structures more directly than would have been the case had other systems been selected. In the sample selection process for the CR-HVAC systems, due consideration was made of review areas that would be adequately covered in the AFW system review. In such cases the review was limited to a confirmation of the applicability of the AFW review to the other systems. This allowed concentration on those topics that were unique and those topics for which the AFW review indicated the need for a larger or more focused sample.

Two major segments in the interface between the IDVP and ICVP which affect the CR-HVAC system evaluation are the component interface and construction/installation interface. The component interface was constructed so that design verification activities at the component level (e.g., reviews of specifications, environmental qualification, and seismic qualification) made use of the same sample of components that are used in the ICVP. This approach creates a common thread between the two programs such that the IDCVP can determine the adequacies of interfaces in the design/construction process of a component from conception through testing for service.

The construction/installation interface provides a method for establishing feedback to the IDVP for verification of identity, dimensional verification, inspection, and testing in the field.

3.3 CR-HVAC SYSTEM DESCRIPTION

The CR-HVAC system, as defined within the IDCVP, is a part of a system designated as control room area ventilation system (CRAVS). CRAVS services the control room habitability envelope (i.e., physical boundaries) and certain other nearby spaces that are not part of the control room habitability envelope, e.g., battery and switchgear rooms. The boundaries of the CR-HVAC system include that portion of CRAVS that services the control room envelope and isolates it from the remainder of the system under postulated accident conditions. This corresponds to the portion of the system that is seismic Category I. Beyond these boundaries, the system does not perform a safety function.

The system consists of two independent trains with separate flow paths interconnected at the air distribution system in the control room. Each train is designed to meet the system requirements without reliance on the other train. Air handling units, filter units, and fans in each train are sized for the entire system requirements.

The air handling units include a fan, electric heating coils, chilled water cooling coils, and a dust removal filter. The filter units are a combination of roughing

filters, high efficiency particulate air (HEPA) filters, and charcoal absorbers for removal of radioactive particulate and gaseous substances.

A simplified process diagram for the CR-HVAC system is provided in Figures 3-1 through 3-3. Only the major components are included to facilitate understanding of the most important aspects of the system. Table 3-1 summarizes pertinent process data for accident and normal alignments, and Table 3-2 tabulates the valve or damper positions for those system alignments.

The protection of control room personnel from toxic gases, which is one of the functions of the CR-HVAC, is influenced significantly by the proximity of industrial facilities near the Midland site. In particular, Dow Chemical, Dow Corning, and the railroad shipments associated with them provide a large number of potential sites for release of toxic substances. Table 3-3 is a reproduction of FSAR Table 2.2-7, which tabulates the chemicals that are present and pose a potential hazard. The design of the CR-HVAC system incorporates unique features to address the presence of these substances. The HGMS uses mass spectrometry to monitor continuously the incoming air for concentrations of these substances. Using a microprocessor, the concentration of each substance is compared to limits established as part of the CR-HVAC design. The HGMS is also equipped with automated calibration and test circuitry.

3.3.1 NORMAL SYSTEM ALIGNMENT

In the normal mode of operation the system performs the following functions:

- Temperature and humidity control
- Replenishment of fresh air
- Maintenance of control room positive pressure

The system also provides cooling in the normal mode for spaces that are not part of the control room envelope; i.e., the switchgear rooms, battery rooms, and cable spreading rooms. The system has two independent 100 percent trains. The

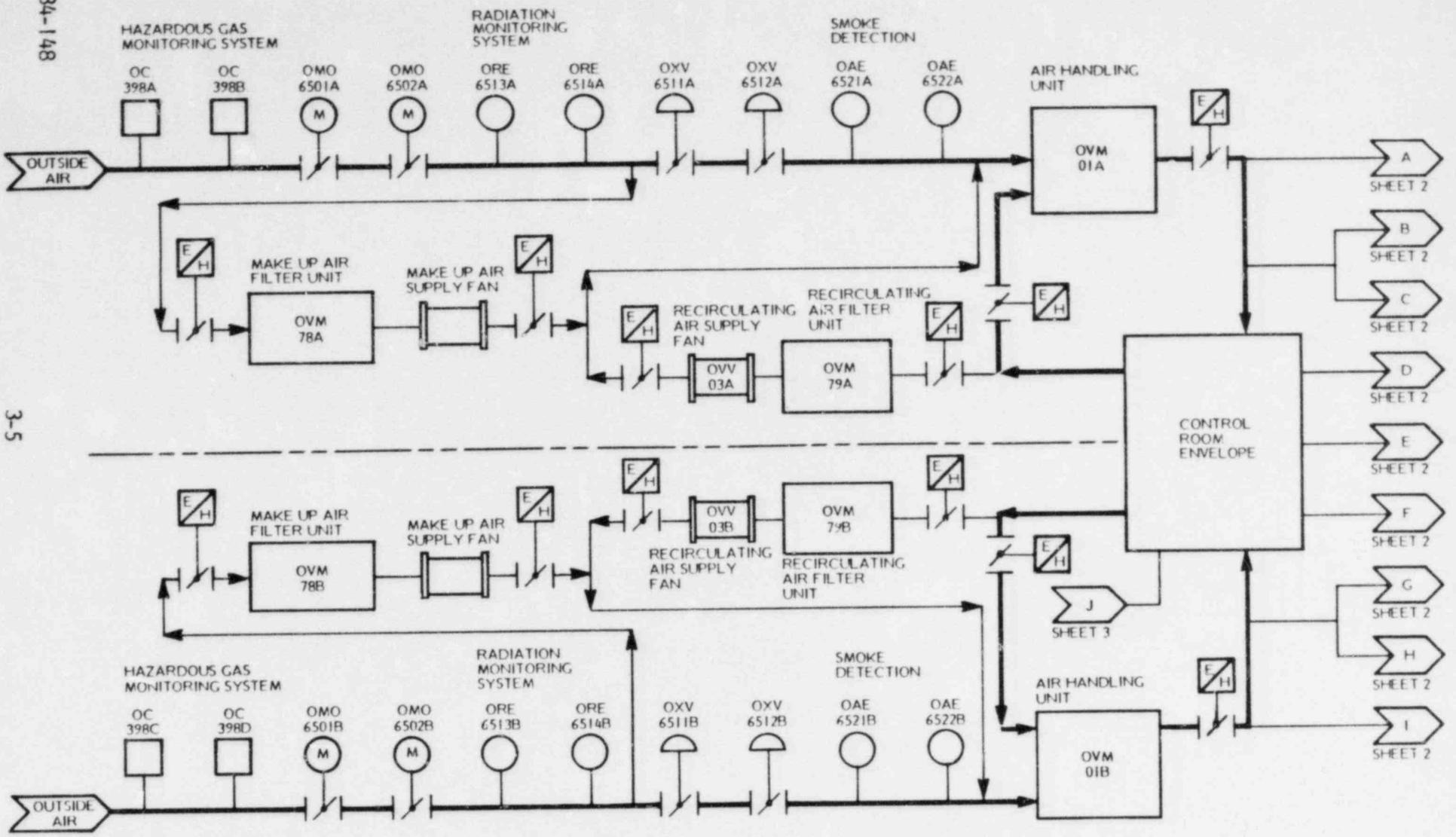

FIGURE 3-1

CONTROL ROOM HVAC SYSTEM
PROCESS DIAGRAM
(SHEET 1)

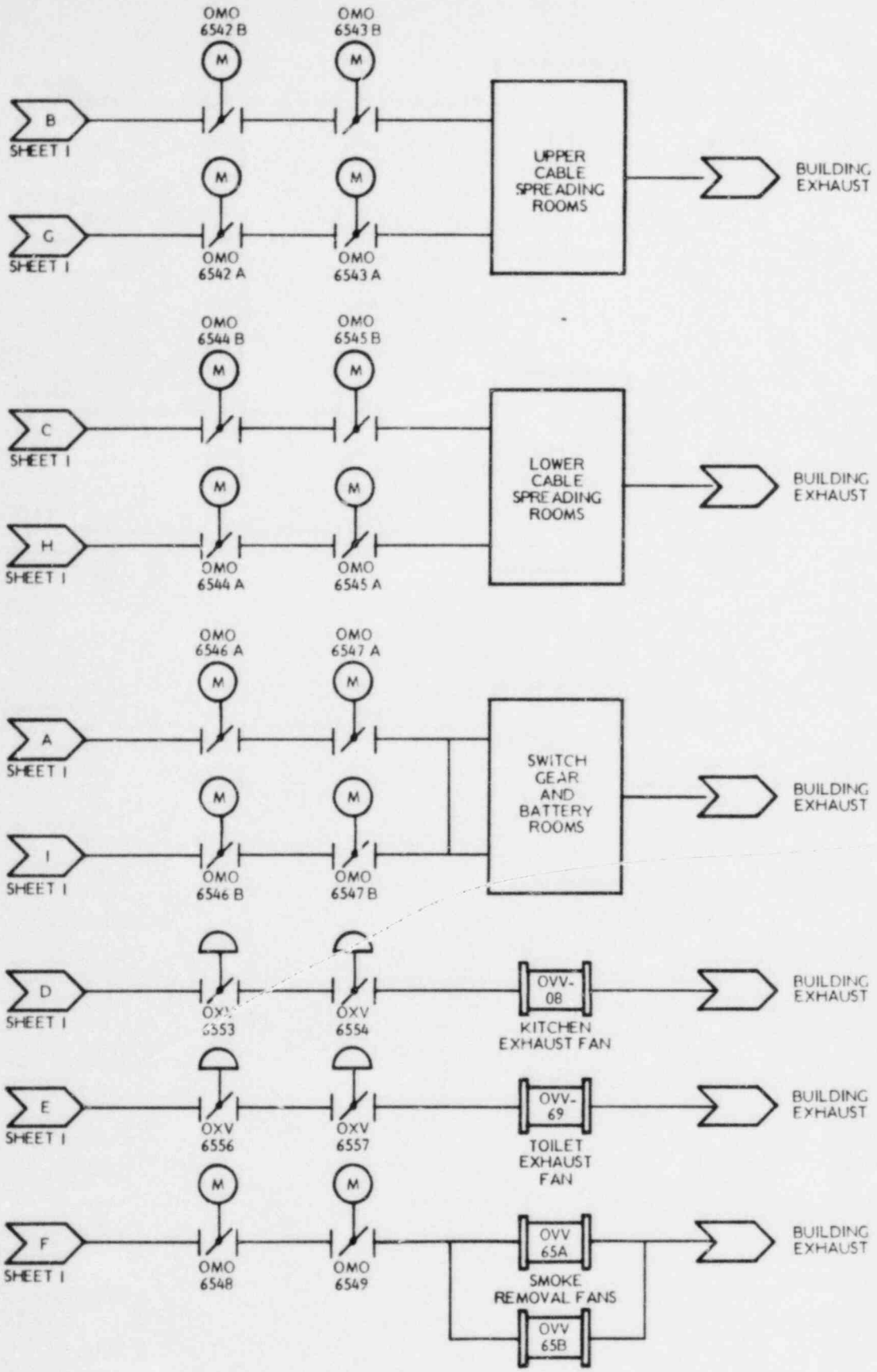

FIGURE 3-2

CONTROL ROOM HVAC SYSTEM
PROCESS DIAGRAM

(SHEET 2)

B-84-148

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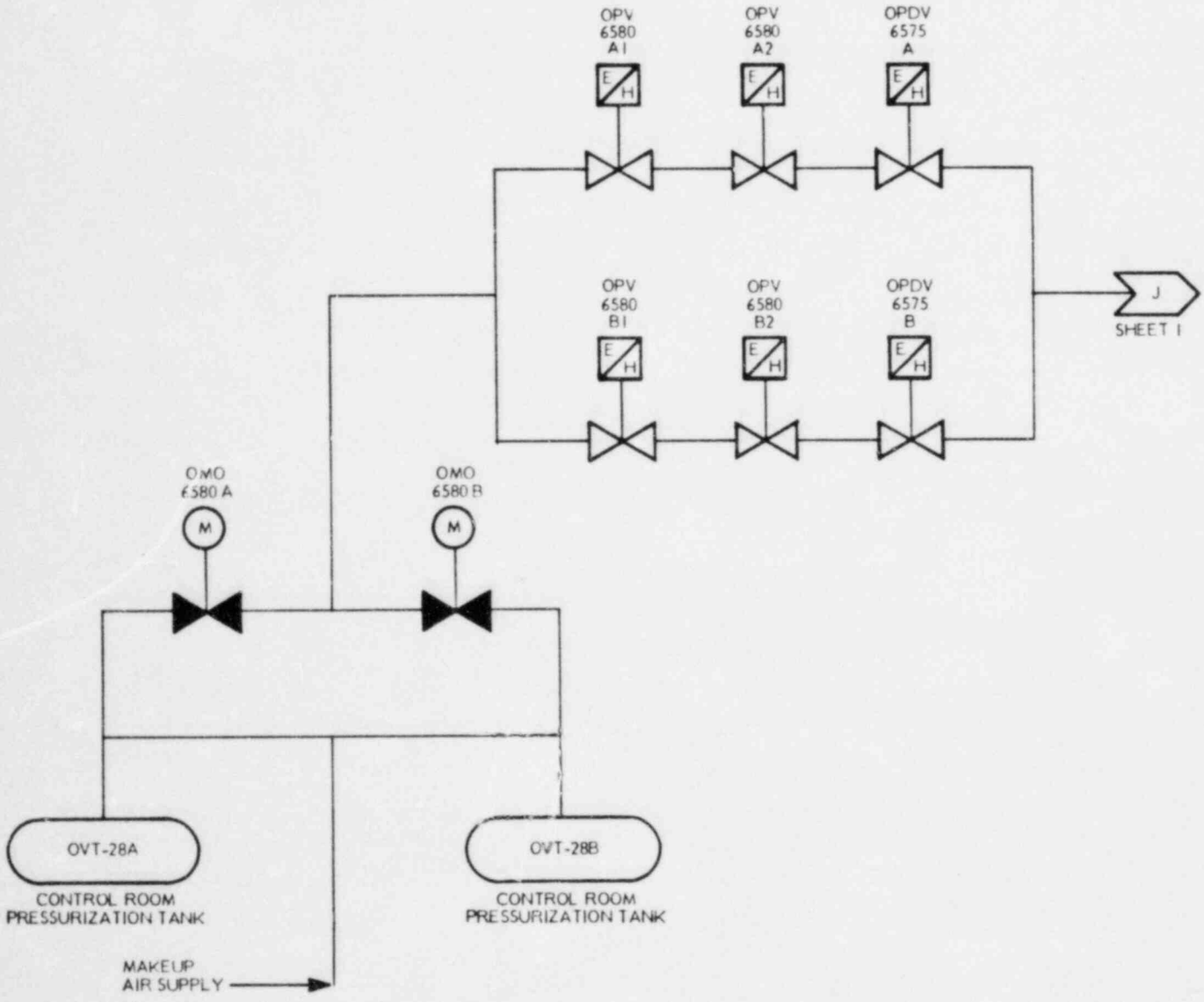

FIGURE 3-3

CONTROL ROOM HVAC SYSTEM
PROCESS DIAGRAM
PRESSURIZATION SYSTEM

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TABLE 3-1

SUMMARY OF DESIGN PARAMETERS

Peak Control Room Temperature (LOCA)	80°F *
Control Room Pressure	+1/4-inch water gauge

System Flow Rates (cfm)	Mode		
	Normal	Isolated	Post Pressurization
Total Recirculation	23,000	23,000	23,000
Makeup	2,000	0	2,000
Recirculation Filter	0	4,000	4,000
Makeup Filter	0	0	2,000

Pressurization System Flow Rate	350 cfm
Pressurization System Supply Duration	3 hrs
Makeup Air Conditions	
Winter Temperature	-10°F
Summer Temperature	96°F
Summer Wet Bulb Temperature	79°F

* Refer to Section 4.2.3.3 for an explanation of the difference between the stated peak temperature and the FSAR value.

TABLE 3-2

MIDLAND UNIT 2
CONTROL ROOM HVAC
DAMPER AND VALVE POSITION TABLE

(O = open; C = closed)

CPC Damper or Valve No.	Operating Mode[1]		
	Normal[2]	Isolated[3]	Post-Pressurization[4]
OMO 6501A	O	C	O
OMO 6502A	O	C	O
OXV 6511A	O	C	C
OXV 6512A	O	C	C
OMO 6546A	O	C	O
OMO 6547A	O	C	O
OMO 6542B	O	C	O
OMO 6543B	O	C	O
OMO 6544B	O	C	O
OMO 6545B	O	C	O
OMO 6501B	O	C	O
OMO 6502B	O	C	O
OXV 6511B	O	C	C
OXV 6512B	O	C	C
OMO 6542A	O	C	O
OMO 6543A	O	C	O
OMO 6544A	O	C	O
OMO 6545A	O	C	O
OMO 6546B	O	C	O
OMO 6547B	O	C	O
OXV 6553	O	C	O
OXV 6554	O	C	O
OXV 6556	O	C	O
OXV 6557	O	C	O
OXV 6548	O	C	O
OMO 6549	O	C	O
OMO 6580A	C	O	C
OMO 6580B	C	O	C

Notes are explained on following page.

TABLE 3-2

(CONTINUED)

NOTES

1 The position stated for the valve or damper is the position when the train is in service. Only one of two trains is required to meet performance requirements in any operating mode.

2 Normal operation refers to the system alignment when toxic substances or airborne radiological hazards are not present.

3 The isolated alignment is utilized to eliminate all makeup air supply.

4 After expending the air supply from the pressurization system tanks the system, at the operator's option, can be realigned to provide makeup air with all flow passing through the makeup air filter unit.

5 All electrohydraulic valves shown in Figures 3-1 to 3-3 are used to modulate flow.

TABLE 3-3

GASES HAZARDOUS TO THE CONTROL ROOM*

Chemical	Source[1]	Maximum Concentration at Control Room Air Intakes (mg/m^3)		Toxicity Limit (mg/m^3)	Display Range (mg/m^3)
		Puff	Continuous		
Acetic anhydride[11]	R	--	60	585[6]	Note 10
Acrylonitrile[11]	R	--	1,160	70[13]	Note 10
Ammonia[4]	R	35,000	940	69[2]	--
Benzene[11]	R	--	900	1,340[6]	Note 10
Butane[11]	R	8,800	5,640	1,900[8]	Note 10
Bromine	R	--	2,020	26[12]	0-13
Carbon tetrachloride[11]	R	--	1,400	12,500[2]	Note 10
Chlorine	R	84,000	8,630	45[2]	0-15
Chloroform[11]	R	--	2,670	10,000[6]	Note 10
Dimethylamine	R	44,000	4,180	45[2]	0-36
Ethylene oxide[11]	R	37,800	1,790	3,600[2]	Note 10
Hexane[11]	R	--	1,520	8,800[6]	Note 10
Hydrogen bromide	DM	6,160	11,600	16[12]	0-670
Hydrogen chloride	R	89,500	5,190	52[2]	0-14
Hydrogen fluoride	DC	1,340	1,310	27[2]	0-8
Methyl bromide	R	4,500	6,010	60[7]	0-200
Methyl chloride	R	87,500	4,230	7,400[6]	0-405
Methylene chloride[11]	R	--	11,800	1,700[7]	Note 10
Oxygen[9]	--	--	--	--	0-25%
Propylene oxide	DM	12,800	1,580	7,100[2]	0-500
Sulfuric acid[5, 11]	--	--	1,370	1[6]	Note 10
Sulfur dioxide	R	17,000	2,120	25[2]	0-12.5
Vinyl chloride	R	92,000	5,070	10,000[2]	0-800
Vinylidene chloride[11]	R	15,800	3,290	1,660[6]	Note 10

Numbered notes are explained on following page.

* This table is a reproduction of Midland FSAR Table 2.2-7.

TABLE 3-3

(CONTINUED)

NOTES

1 R = Railroad tank car located northeast of site on C&O Railway
DC = Dow Corning
DM = Dow Midland

2 Values shown are from the data compiled by Dr. James Wing of the NRC as of January 1976 for an exposure of 2 minutes.

3 Values shown represent the panel display in the control room. These numbers are not related to detector sensitivity.

4 Ammonia will be monitored by the hazardous gas monitor, although low concentrations (5 to 100 ppm) of ammonia would first be detected by personnel in the control room because of the distinct odor. Human detection takes place before 69 mg/m^3.

5 Sulfuric acid is also a product of sulfur trioxide hydrolizing with moisture in the air. Locations of sulfur trioxide are listed in Tables 2.2-4 and 2.2-5.

6 Values for 30-minute exposure based on highest acceptable man (limits) Clayton Environmental Consultants, September 1981.

7 Values shown are adopted threshold limit value -- short-term exp sure limit. Maximum concentration exposure for up to 15 minutes continuously, as given in American Conference and Governmental Industrial Hygienists Handbook 1981 (ACGIH).

8 Values shown are adopted threshold limit values - maximum concentration exposure for 8 hours, as given in American Conference and Governmental Industrial Hygienists Handbook, 1981 (ACGIH).

9 Oxygen is monitored to ensure the oxygen content never goes below 18% volume. This eliminates the need to monitor for asphyxiants.

10 Display ranges will be provided by amendment.

11 These gases are not presently monitored by the hazardous gas monitoring system. However, a prototype of the monitor will be tested to determine its ability to detect these gases. This table will be updated by amendment to reflect this testing.

12 Values shown are for 2-minute exposures based on the highest acceptable limit. Clayton Environmental Consultants, July 2, 1982.

13 Values shown are from Regulatory Guide 1.78, Table C-1.

train that is in service is aligned to circulate air using the air handling unit (OVM-01A or OVM-01B) and to take suction from the outside. Both the makeup air filter unit (OVM-78A or OVM-78B) and the recirculating air filter unit (OVM-79A or OVM-79B) are bypassed in the normal alignment. Electric heaters and chilled water cooling coils that are part of the air handling units are used for temperature control. The fan is sized to deliver the design flows for recirculation and makeup air while maintaining a positive pressure relative to ambient air pressure in the control room of 1/4-inch of water. Control room pressurization is provided to prevent inleakage of toxic gases, radioactive particles or smoke during accidents. During pre-operational testing, dampers are adjusted to balance the flows to match the design and the required control room pressurization is established.

3.3.2 ISOLATED ALIGNMENT FOR ACCIDENT CONDITIONS AND TOXIC GASES

In the normal system alignment the makeup air supply and control room air are continuously monitored for toxic gases, radioactive materials, and smoke. When the potential for such hazards is detected, a control room isolation signal (CRIS) is generated. The signal actuates dampers to isolate the makeup air supply, and the portions of CRAVS that are not part of the control room envelope, (i.e., all dampers on Figure 3-2, receive a signal to close). The cooling for switchgear rooms, battery rooms, and cable spreading rooms is provided by area coolers when the rooms are isolated from CR-HVAC. The signal also opens valves OMO 6580A and OMO 6580B (see Figure 3-3), which initiate flow from the pressurization system into the control room. Dampers in the flow path for recirculating air filtering are positioned to recirculate the design flow through the filter unit.

The resulting system alignment provides a flow path for recirculating the control room envelope air through the air handling unit (OVM-01A or OVM-01B) with a portion of that flow being diverted through the recirculating air filter unit (OVM-79A or OVM-79B). All sources of outside air and all exhausts are isolated. The pressurization system supplies air from pressurized tanks to maintain control

room pressure at 1/4-inch of water gauge for at least three hours as air exfiltrates from the control room. In the isolated alignment the system provides the following functions:

- Temperature control
- Maintenance of control room positive pressure
- An isolated control room volume to prevent entry of hazardous airborne substances

Since the filtering system is not designed to remove toxic chemicals from the air, intake of external air is only allowed if the toxic gas is not present. If the external concentrations of toxic substances remain at hazardous levels, the control room could remain isolated for an extended period (up to five days) without depleting the oxygen to an unacceptable level. After three hours, however, the system is not designed to maintain pressurization without makeup. Infiltration of outside air containing a toxic substance could increase the concentration of that substance to an unacceptable level. The HGMS is designed to display concentrations of the hazardous chemicals inside the control room and trend the change. This information would alert control room personnel to use self-contained breathing devices which are available inside the control room. These devices extend the three-hour habitability period provided by the pressurization system to nine hours, after which the breathing devices must be replenished from offsite sources if the external concentrations remained at hazardous levels.

An important aspect of the CR-HVAC system is the design of the HGMS which detects the presence of hazardous concentrations of toxic gases. The HGMS generates a CRIS based on concentrations of gases in the air entering the air intake duct. The outside concentration limit is set to prevent the concentration inside the control room from reaching unacceptable levels. The level permitted inside the control room is such that the operators will not be subjected to disabling effects of the gas.

The HGMS is designed to detect the presence of as many as 78 toxic gases at concentrations below the hazard level. For selected gases, the system has the capacity to generate an isolation signal within 4 seconds from the time the gas enters the sampling tube. Gases which have acute toxicity or low toxicity limits are included in the set of substances sampled with this response time. The HGMS uses a mass spectrometer as the sensing device. The mass spectrometer ionizes the gas sample and, with the aid of the system electronics, allows ions of specific mass-to-charge ratios to be selected and amplified to provide an output current which is related to the concentration of each gas. The concentrations are compared to setpoints which are based on an analysis of the ventilation system to establish the toxic level at which the CRIS must initiate isolation in order to keep the concentrations at an acceptable level. The setpoints are established for both a slow buildup and a rapid increase. In addition to the comparison with setpoints, the HGMS also monitors rate of change of toxic concentrations. These functions are performed by the HGMS microprocessors.

3.3.3 POST-ISOLATION ALIGNMENT

After the initial isolation period, the system is designed to give the operator an option to return to an alignment that takes in makeup air from the outside. The post-isolation alignment differs from the normal alignment in that the by-pass around the makeup air filter unit (OVM-78A or OVM-78B) is closed; i.e., dampers OXV 6511 A or B and 6512 A or B are closed. The portions of CRAVS that are not within the control room envelope remain isolated. In this alignment all makeup air is processed through the makeup air filter unit and a portion of the control room air which is recirculated is continuously filtered by the recirculating air filter unit. Both filter units contain a combination of HEPA filters and charcoal absorbers, which remove both particulate and gaseous radioactive material from the air.

In the post-isolation alignment, the system provides the following functions:

- Temperature and humidity control
- Maintenance of control room positive pressure

- o Replenishment of fresh air
- o Removal of airborne radioactive substances.

3.4 CR-HVAC SAMPLE SELECTION

3.4.1 BASES FOR SAMPLE SELECTION MATRIX

The system selection criteria discussed in Section 3.1 of this report also guided the selection of specific structures, components, or commodities to be reviewed within each area of the IDVP, as well as the depth of the review in deciding the number and types of design documents sampled. In general, the selection was based on engineering judgment. The bases for these judgements are documented in IDVP engineering evaluations. The sample selected for review appropriately considers information resulting from previous reviews of the AFW system and the project design processes. In order to make use of this information a review was made of 10 CFR 50.55(e) reports filed by CPC, Safety Concern and Reportability Evaluation (SCRE) reports, Management Corrective Action Reports (MCAR), and NRC documentation such as inspection reports and IE bulletins. Areas experiencing repeated problems within the industry or specifically on the Midland project, areas previously receiving less intensive reviews than other areas, and areas where Findings were identified were all candidates for increased sampling of documentation or components. The sample of design documents selected are considered to be sufficiently broad to present a representative sample of the CR-HVAC system.

3.4.2 DETAILED COMPONENT MATRICES

Using the sample selection criteria discussed in Appendix A of the AFW System Performance Requirements Report, and the design criteria and commitments which were identified, a sample of components was selected for the review. These components represent an important interface between the IDVP and the ICVP because a common sample was sought to track the influence of the full project completion cycle on specific components. Where calculations and implementing documents needed to be selected from a number of potential

candidates, those calculations, evaluations, and implementing documents associated with equipment on the detailed component review matrices were preferentially selected. However, in some cases the judgment of the reviewer indicated that other calculations evaluations or implementing documents would be more appropriate given the objectives of the IDVP.

4.0 CONTROL ROOM HVAC SYSTEM PERFORMANCE REVIEW

The sample review matrix (Figure 2-2) was used to define the scope of the Control Room HVAC (CR-HVAC) System Performance Review. All of the topics shown on that matrix are included in this report except for the following:

Topic	Description
1.4-3	Technical Specifications
1.14-3	Preservice Testing/Capability for Operational Testing
1.21-3	Non-destructive Examination (NDE) Commitments
1.22-3	Materials Selection

All of these topics, as well as the System Protection Features topics shown in Section II of Figure 2-3 and the corresponding topics for the other Independent Design and Construction Verification Program (IDCVP) systems, will be covered in a subsequent report, Review of Protection Features and Related Topics.

Except for the four topics discussed above, this report section contains summaries of the review scopes shown in Figure 2-2 for all of the System Performance topics.

This section is organized into two major subsections: Subsection 4.1 which describes the evaluation of the design criteria applicable to CR-HVAC system performance, and Subsection 4.2 which describes the evaluation of the review scopes for those topics on the matrix requiring review activities in addition to the evaluation of criteria. The criteria evaluation subsection discusses CR-HVAC system design criteria for all topics. The review topic evaluation subsection is organized based upon specific topics or groups of related topics.

4.1 REVIEW OF CRITERIA AND COMMITMENTS

The review of criteria and commitments applies to all topics in the CR-HVAC system performance requirements evaluation. The method of review, described in more detail in Appendix A to the Auxiliary Feedwater (AFW) System Performance Requirements Report, is to determine applicable design criteria by reviewing source documents and then evaluating the design criteria against preestablished acceptance criteria. Principal source documents included the Final Safety Analysis Report (FSAR) and Nuclear Regulatory (NRC) regulations. Other sources of criteria included codes and standards referenced by the FSAR and other project documents, NRC regulatory guides and branch technical positions, and other similar documents either referenced in project documents or otherwise known to the members of the Independent Design and Construction Verification Program (IDCVP) review team.

Because no central source existed for these criteria (except for the FSAR), a Consolidated Criteria and Commitments List was prepared. This list is included as Appendix B to this report. The Consolidated Criteria and Commitments List provided a mechanism for ensuring that a consistent set of criteria was used by all team members in the performance of the Independent Design Verification Program (IDVP). The IDVP used the Consolidated Criteria and Commitments List to determine the criteria applicable to each specific review topic. The Consolidated Criteria and Commitments List also allowed the identification of potentially conflicting or erroneous criteria and commitments.

4.1.1 CURRENT CRITERIA

There were no Babcock and Wilcox (B&W) criteria specific to the CR-HVAC system. The FSAR is the only overall criteria document for the Midland Energy Center. Chapter 3 of the FSAR provides the principal criteria for the Midland plant. Section 6.4 of the FSAR, Habitability Systems, addresses the requirements for the ventilation system to deal with airborne radiation and toxic gases, and also describes the methods used to calculate concentrations of toxic gases. Section 9.4.1 of the FSAR, Control Room Area Ventilation System (CRAVS),

describes the CRAVS of which the CR-HVAC is a subsystem, and enumerates the safety and power generation design bases for the CR-HVAC. Section 2.2 of the FSAR, Nearby Industrial, Transportation, and Military Facilities, describes the potential sources of toxic substances that must be addressed in the CR-HVAC design and tabulates a data base for the toxic substance assessment.

General Design Criteria (GDC) 19 from 10 CFR 50, Appendix A, is specific to the system performance review topics, and the Midland FSAR commits to compliance. Regulatory guides specific to these topics are listed below:

1.4 Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors

1.52 Design, Testing, and Maintenance Criteria for Postaccident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants

1.78 Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release

1.95 Protection of Nuclear Power Plant Control Room Operators Against an Accident Chlorine Release.

Compliance with these and all other Regulatory Guides is discussed in FSAR, Appendix 3A.

The position taken in Appendix 3A and the Regulatory Guides themselves were the bases for identifying applicable criteria from the Regulatory Guides.

4.1.2 CONSOLIDATED CRITERIA AND COMMITMENTS LIST

Since the criteria and commitments applicable to the CR-HVAC system were not compiled in one document but were found in the FSAR and NRC regulations, it was determined that a consolidated list of criteria would enhance the review process. This need was first recognized because of the overlapping, redundant, and potentially inconsistent criteria and commitments which could be found in

these various documents during the AFW review. Based on the AFW review, it was decided to prepare consolidated criteria for all IDVP systems. The Consolidated Criteria and Commitments List (see Appendix B) was developed by reviewing appropriate sources of criteria and commitments, extracting applicable criteria and commitments, and determining the review topics to which the criteria and commitments apply. The Consolidated Criteria and Commitments List was then used by the IDVP reviewers to ensure consistency in the reviews with respect to the applicable criteria for the CR-HVAC system. Furthermore, the Consolidated Criteria and Commitments List was used to identify the existence of potentially deficient, inconsistent, or inadequate criteria. The engineering evaluations performed for the CR-HVAC system used the Consolidated Criteria and Commitments List.

4.1.3 EVALUATION

For each engineering evaluation involving a review of criteria and commitments, acceptance criteria were developed for evaluation of the design criteria. The acceptance criteria were developed by IDCVP team members using requirements contained in the Project Quality Assurance Plan (PQAP) and their judgement. The applicable acceptance criteria are documented in each engineering evaluation.

For the review of criteria and commitments, the following general acceptance criteria were used:

- Consistency of criteria and commitments (i.e., whether the set of criteria and commitments are internally consistent)
- Completeness of criteria and commitments (i.e., whether the set of criteria and commitments addresses all necessary design areas)
- Adequacy of detail in criteria and commitments (i.e., whether adequate information is provided to allow implementation).

These acceptance criteria are applicable to all of the review topics.

Additionally, the collective experience of the review team is utilized to take a broader view of the system design criteria. Regulatory guidance is a major factor in making this type of assessment; however, the review goes beyond an assessment of the degree of compliance with detailed regulatory requirements.

All criteria for system performance requirements were evaluated collectively. The conclusion of the evaluation was that an adequate set of criteria was established for the system performance requirements. In some areas explicit details were not stated in the FSAR; however, review of the implementation indicated that the level of detail was sufficient to control the design. The more detailed levels of criteria were often stated within the calculations or other documents reviewed amplifying the more general statements in the FSAR. As an example, studies performed by Clayton Environmental Consultants, Inc., a consultant to Consumers Power Company (CPC), very explicitly identified the physiological basis for setting toxicity limits for the substances being studied, whereas the FSAR was less specific. This level of refinement during implementation was typical for various areas of criteria implementation, supporting the conclusion that sufficient detail did exist to direct the design activities.

In reviewing the Midland position on the applicable Regulatory Guides, the exceptions taken were assessed to determine if the design intent had been satisfied. In general, the exceptions noted were determined to be acceptable. Regulatory Guide 1.95 provides criteria for the design of the CR-HVAC to address hazards of a chlorine gas release. The guide establishes six types of control rooms based on several parameters and states criteria based for each type. The position taken by Midland is that none of these types directly apply, but that the design meets the intent. In the criteria review, compliance with each technical position was determined based on a conservative assignment of control room type. That review identified three areas where commitments were not made that paralleled the guide, as follows:

- Isolation time for air intake duct
- Normal air exchange rate
- Testing for gross leakage

Subsequent review beyond the criteria level determined that the design isolation time did comply with the Regulatory Guide. Testing for gross leakage will be addressed in a subsequent report, System Protection Features and related topics. The remaining issue was air exchange rate. The Regulatory Guide prescribes a maximum between 0.3 and 1.0 volume exchanges per hour. Midland has an exchange rate of approximately 3.0; however, the limitations of the Regulatory Guide which are not based on any analysis applicable to Midland it was decided within the IDVP that the intent of the Regulatory Guide was to establish measures which would limit concentrations of chlorine to acceptably low limits. Establishing a design criterion which directly limited concentrations was accepted as technically adequate for consideration of hazards associated with chlorine gas. Implementation of that criterion would result in other design features which still met the intent.

In the process of the criteria review three OCRs were confirmed and later resolved without a Finding. These were:

C-066

C-074

C-075

Additionally, an Observation, B-067, was made. These four items were resolved upon receipt of information clarifying statements in the FSAR. Importantly, no indication was found in the subsequent review of design documents that the designers lacked understanding of the criteria. Confirmed Item C-066 required clarification of the requirement for alignment of the system after three hours of insolation. The FSAR stated that the alignment would be selected by control room personnel, depending on outside conditions. The clarification required was the requirements imposed on the system to allow this option.

Confirmed Item C-075 was concerned with a Regulatory Guide 1.78 position that the design consider an infiltration of 10 cfm. This was resolved because the Regulatory Guide does not impose this requirement if there are air locks. The

double door entry in the access design is sufficient to act as an air lock in this capacity.

Confirmed Item C-074 dealt with the design basis for CR-HVAC performance during a postulated station blackout. CPC does not consider the station blackout event to be a design basis for the CR-HVAC. Depending upon external conditions during the event, control room temperatures may increase; however, a calculation had been performed which indicates that the temperature within the control room would remain within acceptable levels for a two-hour blackout. Considerable conservatism was incorporated in that calculation, which means the calculated peak temperature is significantly higher than could actually be expected to occur. The calculation is an example of implementation of design practice which exceeds the committed FSAR criteria. Subsequent reviews of calculations showed that it was common practice to incorporate criteria or assumptions within the calculation which similarly extended the performance capabilities beyond those stated in the FSAR. Most cases were of minor significance, but collectively are indicative of a conservative approach to meeting criteria.

In summary, an adequate basis for design was established. That basis is documented in the FSAR. The AFW System Performance Requirements evaluation and report identified a potential generic concern associated with the lack of centralized design criteria for the AFW system. This concern served as input into the IDVP review of the CR-HVAC, principally to determine if the FSAR was sufficient as the only criteria document. The basis for assessing this question was to examine not only the criteria but the implementation of those criteria in the CR-HVAC design. The design criteria were occasionally difficult to identify and required clarification as noted previously, however, the criteria were found to be correctly implemented which is considered adequate assurance that the criteria document (the FSAR) was sufficient for use by the CR-HVAC design organizations in promulgating criteria. The issue as it potentially relates to other aspects of the design and other organizations remains under review and conclusions will be documented in a report on the IDVP integrated assessment.

4.2 REVIEW TOPIC EVALUATIONS

This section describes the evaluations performed on the review topics described in the sample review matrix in addition to the criteria and commitment review discussed in Section 4.1 of this report. As shown on the sample review matrix (Figure 2-2) and discussed in more detail in the Engineering Program Plan (EPP), the reviews performed in addition to the criteria review included review of implementing documents, check of calculations and evaluations, and check of drawings and specifications. In addition, confirmatory calculations or evaluations were performed for selected review topics. No expansions of the sample review matrix were necessary. This section consists of three subsections which discuss the review topics within the scope of the System Performance Review Report. These subsections are System Evaluation; Mechanical Evaluation; and Electrical, Instrumentation and Control Evaluation. The system evaluation discusses those topics that are related to the general system performance requirements and that implement the most general functional requirements of the system, such as system operating limits and applicability of the single-failure criterion. The mechanical evaluation discusses topics associated with the mechanical design aspects of the system. Included are topics such as component functional requirements, system pneumatic design, and filtration. The electrical, instrumentation and control evaluation discusses all electrical, instrumentation and control-related topics including power supplies and actuation systems.

The design review in some cases combined topics to integrate the areas where the design aspects were closely associated in each topic. Engineering evaluations were also documented on that basis; however, the organization of this report corresponds to the individual topics from the EPP. This is done to facilitate the tracking of the progress of review from planning to completion.

4.2.1 SYSTEM EVALUATION

4.2.1.1 SYSTEM OPERATING LIMITS -- TOPIC I.I-3

In addition to a review of criteria the scope of review included implementing documents and evaluations. The intent of this review topic is to identify the performance parameters on which the design is based, such as temperature, humidity, acceptable concentrations of toxic chemicals, radiation levels, etc., and to determine if these parameters meet the applicable habitability criteria. In many cases a system operating limit was calculated as part of a calculation covering other design aspects. This resulted in calculation reviews which applied to this and other IDVP topics.

The FSAR provides both general criteria and specific parameters that must be met for control room habitability. For example, conditions for temperature and pressure, toxicity limits, and maximum radiation doses are stated in the FSAR. As such, there is a direct correspondence between criteria and the system operating limit. These limits were reviewed and found to be acceptable based upon regulatory positions and technical literature covering toxic effects. In the case of toxicity limits, the limiting concentrations are taken directly from regulatory guidance, industry accepted positions documented in literature, or from comprehensive studies for selected chemical species. Regulatory guidance, selected literature and special studies were examined and the toxicity limits were determined to be acceptable to ensure that control room personnel could function unimpaired by adverse physiological effects.

Radiation dose limits are taken directly from GDC 19, as interpreted in the Standard Review Plan (SRP), Section 6.4, which is an acceptably conservative basis. Temperature and humidity are limited to the comfort range per American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) standards during normal conditions. The peak temperature following a LOCA is limited to 80°F, which is no longer within the comfort range, but it is still acceptable for control room habitability, and is a more conservative value than other nuclear plants have used for accident conditions. Refer to Section 4.2.3.3

for a discussion of the temperature limit established in the FSAR. Carbon dioxide levels are calculated to be significantly less than one percent in the event that seven people are isolated in the control room for five days.

An Open Item O-060 was issued which dealt with an apparent lack of documentation for control room volume and later resolved without becoming a Confirmed Item when the calculational backup was found.

No separate implementing documents were issued other than the FSAR which, as discussed above, made direct commitments for specific operating limits. The basis for the operating limits, including calculations and toxicity evaluations documented in a report by a CPC contractor, Clayton Environmental Consultants, were reviewed and determined to be acceptable, because they were consistent with the guidance provided in Regulatory Guide 1.78.

4.2.1.2 ACCIDENT ANALYSIS CONSIDERATIONS -- TOPIC I.2-3

The scope consisted of review of design criteria and commitments, and implementing documents. The FSAR was reviewed to determine system performance requirements for accident conditions including onsite postulated events and offsite accidents which would jeopardize control room habitability. The Piping and Instrument Diagram (P&ID) and the flow diagram were the only applicable implementing document.

CR-HVAC system design includes consideration of both normal and accident conditions; however, accident conditions generally present the most demanding set of performance requirements. Normal operation is essentially only a temperature controlling and pressurization function. Because the accident conditions establish the most limiting requirements for system operation, the accident analysis considerations were integrated with the review of system operating limits.

The system functional design requirements as established in the FSAR were reviewed, and it was determined that they adequately addressed all accidents

postulated in the FSAR which include the range of credible accident conditions for both radiological and chemical releases. Chemical release from the Dow facilities is postulated in the same manner as releases of stored or transported material near any nuclear power plant.

The particular interest in a postulated release of toxic substances is due to these nearby Dow facilities. Refer to Table 3-3 for a list of the toxic substances. Both Dow Chemical and Dow Corning facilities have tanks or railroad cars, which could potentially release toxic gases at a distance of less than one mile from the Midland Energy Center. The toxicity of several of the substances in the tanks and cars is very high. To protect against a release of any one of the toxic substances it is necessary to detect its presence and isolate the control room in sufficient time to prevent control room concentrations from reaching unacceptable levels. The requirements established for detection of a hazard and isolation of the control room were based on models for dispersion of the gases in accordance with Regulatory Guide 1.78. As a second means of detection, Dow maintains an emergency plan with an alert system which includes a dedicated phone line to the Midland Energy Center in addition to the other audible warnings in case of hazardous substance release. The emergency plan is annually field tested under hypothetical emergency conditions. Although the Dow emergency plan is considered by CPC to be the primary means of notification of a chemical release, no explicit credit is taken in selecting parameters for calculating the concentrations of chemicals released. The IDVP took the position that the hazardous gas monitoring system (HGMS) was the primary means of detection.

Two OCRs were issued for this topic. The concern in Confirmed Item C-075 was the assumed inleakage for analysis of radiological or chemical hazards. For any period when the control room is pressurized, the assumption is made that no infiltration occurs from outside the control room. However, Regulatory Guide 1.78 takes the position that a nominal 10 cfm inleakage should be assumed even with pressurized control rooms, unless there are air locks. Access to the control room is through double doors. It is the project position that these double doors meet the intent of Regulatory Guide 1.78. The IDVP concurs and the OCR was resolved without issuing a Finding.

Open Item O-083 was resolved prior to becoming a Confirmed Item. It dealt with criteria for addressing the effects of a simultaneous release of more than one chemical. NUREG-0570, Toxic Vapor Concentrations in the Control Room Following a Postulated Accident Release, states that the probability of coincidental release and reacting of two chemicals generating a toxic substance is so low that it has not been necessary to consider such an event. The position in NUREG-0570 approach is considered an acceptable basis at Midland given the prompt notification under the Dow emergency plan. It was also determined by the IDVP that any of the toxic substances would be detected in the presence of other substances given the physical nature of mass spectrometry detection employed (as discussed in Section 4.2.3.1). The OCR was resolved after these issues were considered by the IDVP project team.

The criteria and commitments review for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. Through a review of implementing documents and a review of the way that the accident analysis considerations were integrated into the other related topics, it was concluded that the CR-HVAC design adequately addressed this topic.

4.2.1.3 SINGLE FAILURE ANALYSIS AND FAILURE MODES AND EFFECTS ANALYSIS -- TOPICS I.3-3 AND I.23-3

The scope for this review consisted of a criteria and commitments review, a review of implementing documents, and a check of calculations or evaluations. It was noted during the AFW review that no consolidated documentation packages for either the single-failure evaluation or failure modes and effects evaluation existed. These evaluations were performed through a series of individual evaluations conducted over the duration of the Midland project. Summary results are presented in the FSAR, but a complete supporting evaluation could not be located.

Single-failure and failure modes and effects are very closely related topics for the CR-HVAC system. The FSAR documented the failure modes and effects analysis, but no separate single-failure evaluation was developed. This is not

unexpected considering the simplicity of the system and in particular the absence of complex interaction. In lieu of a review of an existing evaluation or calculation, the single-failure design was independently evaluated under this review topic. The primary documents used to address the adequacy of the design were the FSAR, to establish criteria and commitments, and the P&ID. The single-failure evaluation was based on Regulatory Guide 1.53 requirements using the methodology of IEEE 379-1977. All safety-related functions for the entire system design were included.

The fundamental design concept used to assure single-failure protection is the provision of two independent 100 percent capacity trains with redundant isolation capability in each train. To confirm the implementation of the concept, the component functional requirements and power supply topics included the aspects related to meeting the functional requirements.

It was determined that the single-failure design was adequate with one exception. The design does not allow remote re-initiation of makeup air flow in the event of a single failure that incapacitates one of the two power supply trains. Isolation dampers in each train would in this case fail as is (closed) and prevent makeup flow alignment. This realignment may be required following a release of a radioactive substance. It would not be required following a toxic chemical release. This was the subject of Confirmed Item C-097. This capability to provide single-failure design for both isolation and subsequent return to an open condition is addressed in SRP Section 6.4, Appendix A (NUREG 0800 Rev. 2). The position was taken by the project that an acceptable alternative is manual override provided certain conditions are satisfied. Appendix A to SRP 6.4 was used as a criteria document for reviewing the design to determine if manual override would be accepted, and based on that review the determination was made that manual override was acceptable. Damper design, local accessibility, distance from the control room, damper reliability, radiation exposure, and electrical disconnect aspects were all evaluated.

Collectively, the Appendix A criteria ensured that the location and design of the dampers was such that they could be manually operated under the conditions that would exist following a LOCA.

The design for single-failure considerations was evaluated to be adequate given the credit taken for manual override as a means of returning to the makeup air flow alignment subsequent to the initial isolation for three hours.

4.2.2 MECHANICAL EVALUATION

4.2.2.1 COMPONENT FUNCTIONAL REQUIREMENTS -- TOPIC I.9-3

System design imposes requirements on the components in the system. Those requirements which involve the functional operation of the component and the compliance with licensing commitments or industry codes are reviewed under this topic. Seismic and environmental qualifications are considered separately in a subsequent report, System Protective Features. The scope of the review includes criteria, implementing documents, calculations, and technical specifications within procurement documents.

With respect to component functional requirements, the culmination of design efforts is the issuance of technical specifications for procurement. Under this topic the parameters which define the component performance were traced from their origin in criteria through any required calculations, and then the specification was reviewed to demonstrate consistency with the stated or calculated requirements. Where licensing commitments were made for compliance with industry codes such requirements were checked in the specification. Additionally, vendor documents were checked in selected cases to confirm specific requirements against that specified.

The types of components reviewed were fans, dampers, filtering units, and detection equipment. Parameters checked included fan delivery capacity, total static pressure, efficiency and driver horse power; pressurization system tank size; damper sizing and closure time; and filtering unit efficiencies for various

types of radiological hazards. The review indicated that the component functional requirements imposed by system design had been adequately addressed. Among the most complex of the components reviewed was the HGMS, which detects the presence of potentially hazardous concentrations of toxic gases and generates a signal to isolate the control room. The determination of the set of chemicals to be monitored and their detection setpoints was reviewed in detail, including the reports developed by consultants under contract to CPC.

The capability of the HGMS to detect any of the toxic gases at a concentration and in sufficiently short interval to prevent unacceptable concentrations inside the control room was reviewed. Included was the capability to detect one chemical in the presence of others. The monitoring system was designed to detect preselected peaks from mass spectrometer analysis of continuous samples of incoming air. The presence of any peak in sufficient concentration generates the signal that isolates the HVAC intake. This design makes it possible to isolate for a toxic substance regardless of the presence of other chemicals in the sample. Based on the review the assessment was made that the technical specification of the monitoring system was adequate.

An Open Item O-127 was dispositioned as an Observation which concerned the fact that inconsistencies existed between fan horsepower assumed in a calculation and that specified for procurement. The purchase specification was determined to be technically adequate despite the inconsistency because the specified horsepower was sufficient to drive the fan under required conditions. Confirmed Item C-129 questioned the time required to close certain dampers following a control room isolation signal (CRIS). The dampers first reviewed closed in three seconds and should have closed in two seconds. It was later determined that another redundant set of dampers which are in same the flow path closed in one second. This was rapid enough to satisfy design requirements. Accordingly the item was resolved.

The design has progressed to a sufficient state of completion that the review of component functional requirements can be considered complete. In reaching this

conclusion, consideration was given to the fact that the HGMS was still undergoing tests for selected chemicals to establish what minimum level concentrations can be detected. Similiar tests on the other toxic gases have, however, been completed, and the design methods and implementation for these have been reviewed. To finalize the documentation supporting the design of the hazardous gas monitoring system, the results of those tests will have to be evaluated using the methodology established previously and used for all the other substances. The test results are not expected to result in any change in the system, but the documentation of tests and incorporation of final data in analysis of setpoints will be reviewed prior to closing the IDVP.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. Based on review of P&IDs, calculations, and specifications conducted in conjunction with other topics, it was concluded that the technical specifications within procurement documents provided an adequate definition of component functional requirements, consistent with the system design and the overall criteria.

4.2.2.2 SYSTEM PNEUMATIC DESIGN -- TOPIC I.10-3

The pneumatic design was reviewed in conjunction with pressurization and ventilation topics since these aspects of the design are integrated in the design documents and in the calculations which support them. Criteria were reviewed, as discussed in Section 3.1, and those criteria formed the basis for a review of implementing documents, calculations, and drawings. Additionally, confirmatory calculations were performed that covered design aspects in both pneumatic design and ventilation, which are closely related.

The most significant design aspect that was subjected to review under the pneumatic design topic was the ability of the fan to develop required flow. This was coupled with control room pressurization, because the fan must develop the flow in the presence of a 1/4 inch of water pressure differential to maintain control room pressurization. In addition to this one-dimensional pressure drop consideration in the design, local effects of HVAC flow distribution were

subjected to review. This was critical for assessing concentrations of toxic substances in the control room. Local flow distribution was not explicitly addressed in Bechtel calculations; therefore this area was selected as the subject of a confirmatory calculation which dealt with both system pneumatic design and ventilation topics. The confirmatory calculation for local flow distribution are discussed under the ventilation review topic in Section 4.2.3.6.

The principal interest in system pneumatic design is to ensure that the fan can produce a flow rate consistent with the flow diagram data, which are then used in other aspects of design. The calculation for the pressure drop in the most limiting alignment was reviewed and based on that review it was determined that adequate consideration of system pressure drop had been incorporated.

As part of the review a simple model for pressure balance for both recirculation and make-up air flow paths was independently developed and, using the static pressure drops from the Bechtel calculations for segments of the ductwork, a comparison was made. The FSAR pressurization criterion requires a 1/4-inch water positive pressure in the control room relative to the outside. To produce this, fan static pressure had to exceed the pressure drop in the ducts by 1/4 inch water. Comparing the fan static pressure requirements from the independent calculation to the modeled flow path used by Bechtel, the values differed by 0.05 inch water. This results in a minor difference (less than 1%) in calculated fan requirements, which was insignificant. The difference noted above was the subject of observation B-128 because of the minor disagreement in modeling approach.

The review verified that when the system is aligned in a configuration which produces the greatest demand on the fan, which is part of the air handling unit (OVM-001), the fan can produce the required flow.

The P&ID and flow diagrams were adequate for implementation. Calculations were the major mechanism for ensuring the design satisfied the requirements of this topic and their review determined that the pneumatic aspects of the design had been adequately considered. Drawings were used to extract data for the

calculations. The input data were checked in the calculation review. The confirmatory calculations which were performed in conjunction with the ventilation review topic will be discussed in that section of the report. The review concluded that adequate consideration to pneumatic aspects had been incorporated in the design.

4.2.2.3 COOLING/HEATING REQUIREMENTS -- TOPIC I.12-3

The review of the cooling/heating requirements topic included criteria, implementing documents and calculations. The review was conducted to determine if heating and cooling loads in the design of the system were adequately considered. The air handling unit in each train of the system is sized for 100 percent capability to provide temperature control for the control room envelope. The review focused on the cooling load which was the most limiting requirement in establishing temperature control.

The temperature control for the control room requires adequate heating and cooling for the most limiting plant conditions and outside temperatures. Separate analyses were performed by Bechtel to determine the heating and cooling loads under the conditions that were limiting. The most limiting demand is post-LOCA cooling, which was the focus of a detailed review and a confirmatory calculation.

The sizing of the procured cooling coil was established prior to significant changes in control room design, which subsequently led to substantial increases in the heat generated from electrical loads inside the control room envelope. Initial Bechtel calculations, based on conservative approximations for the total cooling load, raised a question in the designer's mind regarding the adequacy of the coil. A comprehensive reanalysis was performed by Bechtel. The basis of the previous calculation were refined, eliminating certain arbitrary conservatisms; however, the basis for the revised analysis still included upper bound parameters for maximizing the cooling load. Assumed outside temperature conditions were more severe than ASHRAE design conditions require. ASHRAE

data are typically the standard for power industry, general industry and commercial HVAC design. Full makeup flow of these elevated temperatures was assumed when it would be possible to reduce that flow and still meet all other ventilation system requirements. Additionally, the calculation conservatively included the heat generated by certain non-essential electrical, instrumentation and lighting which could be shut down by control room personnel if temperatures in the control room were rising.

Based on the analysis, the peak temperature would not exceed 80°F with acceptable humidity levels. The FSAR committed to maintaining the temperature at a level suitable for prolonged occupancy through the duration of the design basis accidents. It was further stated that the temperature would be maintained at 75°F. This temperature was information based on earlier calculations. The IDVP concluded that the commitment was to a suitable temperature and that 75°F was not a committed upper bound to control room temperature. The question raised was the suitability of 80°F. Based on ASHRAE Standard 55-74 this is within 3°F of the comfort range in a region considered comfortable to slightly warm. This also compares favorably with technical specification limits for control room temperature of other nuclear plants where temperatures are allowed to exceed 80°F. The confirmatory calculation, which was performed, supported the conclusion that 80°F would be a peak temperature. Additionally, no credit was taken for reduction in temperatures due to the effects of building structures acting as heat sinks during long term temperature transients. The high heat capacity of massive concrete structures would somewhat reduce temperatures compared to those predicted utilizing peak outside temperatures.

After performing the confirmatory calculation and reviewing a revised Bechtel calculation on the same subject, an Observation B-167 was issued to document minor inconsistencies between the Bechtel calculation references and data in the calculation. The two most significant inconsistencies were a difference makeup in flow rate, 23,000 cfm in the calculation and 21,500 cfm in the flow diagram, and the peak control room temperature allowed 80°F in the calculation and 75°F in the FSAR. In the first case, a later revision to the flow diagram changed the

flow rate to agree with the calculation. The 80°F temperature requires an update of the FSAR. The observation was noted to identify the inconsistencies, but no technically significant concerns remained.

Confirmed Item C-073 was concerned with the assumption used for temperatures in rooms adjacent to the control room. The temperatures associated with a post LOCA condition were used. In the event of a high energy line break in the control room vicinity higher temperatures might have occurred. This item was resolved after determining that the temperatures used enveloped any condition including any high energy line breaks postulated by the project. On this basis, the Confirmed Item was resolved.

Confirmed Item C-076 identified data in a calculation for which no specific references were identified. The data were makeup flow rate, auxiliary building temperature, and design conditions for make-up air. For each of these a supporting source was identified by the project and those sources were determined by the IDVP to be adequate. Make-up flow is documented in flow diagrams and the FSAR. The auxiliary building temperature was the temperature used in adjacent rooms as discussed above, and the design basis makeup air conditions are more limiting than the most limiting weather data and design conditions tabulated in the ASHRAE Handbook. The item was resolved.

The criteria and commitments review for this topic was found to be complete, consistent, and sufficiently detailed to allow implementation. (Refer also to Section 4.1.3 for a discussion of the station blackout event.) The P&ID was used as an implementing document insofar as the related equipment and aspects of system design were identified there. The calculations used to set the cooling and heating loads were adequate. An additional confirmatory analysis was performed to address OCR 058 and it supported the conclusions of the Bechtel calculations. It is concluded that this topic has been considered in the design of the CR-HVAC in an adequate manner.

4.2.2.4 FILTRATION -- TOPIC I.33-3

The filtration review topic addresses the aspect of the system utilized to lower radiation doses for control room personnel. Credit is not taken for filtration in determining toxic gas concentrations. The review scope includes criteria and commitments, implementing documents, calculations, and the technical specification within procurement documents.

The worst-case radiation dose accident postulated is a LOCA. Regulatory Guide 1.4 establishes a set of conservative assumptions used in evaluating the radiological consequences of a LOCA. These assumptions were used for calculating the dose inside the control room by combining the Regulatory Guide assumptions with a model of the HVAC system. In the model no infiltration or air intake is assumed for the first three hours. After three hours the system is aligned to take makeup air through the makeup air filtering unit. The control room remains pressurized. Two filtering units are utilized to limit the dose. First, all makeup air flow passes through a filtering unit. Second, a portion of the recirculating control room air is continuously diverted through another filtering unit. These filtering units are modeled in the accumulative dose calculation following a LOCA. The parameters used to model the performance of the filtering units are consistent with those specified in the procurement documents. Based on the review of the Bechtel analysis the doses to personnel inside the control room will be less than those allowed in GDC 19 as interpreted in the SRP, Section 6.4. No OCRs specific to this topic were issued.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. The design aspects related to control of radiation doses inside the control room have been reviewed including the system design documented on the P&ID, calculations for dose, and the technical specifications within procurement documents for the filtering units. The conclusion of that review is that the design has adequately addressed the aspects related to the filtration topic and that it satisfies the criteria.

4.2.2.5 PRESSURIZATION -- TOPIC I.34-3

The pressurization topic covers those aspects of the design which provide a positive pressure in the control room relative to the outside or adjacent spaces which are not within the control room habitability envelope. The review scope covers criteria and commitments, implementing documents, calculations, and drawings and specifications. The leak rate determination, interfacing pneumatic design aspects, pressurization system design, and provision for postpressurization are all covered under this topic.

A key design feature of the habitability system for the control room is maintenance of a positive pressure inside the control room. The FSAR commits to a 1/4-inch water positive pressure differential between the control room and spaces external to the control room envelope. That pressure differential is to be maintained during normal operation and for a three-hour period following isolation of the control room in response to a radiological or toxic gas hazard. The 1/4-inch water pressure differential is established as a design and operational criterion in the FSAR. Regulatory Guide 1.78 takes the position that inleakage is to be calculated using a 1/8-inch water pressure differential for unpressurized control rooms. The margin provided by the pressurization over that differential is considered adequate to account for any localized regions of higher external pressure which might otherwise cause infiltration. The Regulatory Guide also requires a nominal 10 cfm inleakage for pressurized control rooms unless air locks are provided. The project took the position that this condition was met and the IDVP assessed that position to be acceptable. See Section 4.1.3 for a discussion.

The maintenance of the pressure differential during normal operation is a function of the pneumatic design of the system. A simple analytical pressure balance with the system in the normal configuration was used in the review of the pneumatic review topic, Section 4.2.3.2. Included was the required 1/4-inch differential. Imposing that balance on the external static pressure drop establishes the requirement for fan performance to maintain the differential. The fan performance parameters were reviewed under the component functional

requirement topic (Section 4.2.3.1). The review determined that the system could meet the required pressurization under normal alignment. Preservice testing should provide additional verification of that capability, which will be one item reviewed under topic number I.14-3 to be included in protection features review.

The three-hour pressurization following isolation is the function of the pressurization system. That system provides a controlled release of bottled air at a rate of 350 cfm into the control room after actuation in response to a CRIS. The basis for sizing the air tanks is the calculated leakage rate from the control room. The leakage rate is calculated in accordance with methods identified in the FSAR. These calculations were reviewed and determined to be adequate. Such calculations are dependent on specific design details for the potential leak paths, which are being reviewed under the Material Selection Topic (I.22-3) and Leak Tightness topic (III.9-3). Further confirmation is to be provided during testing, which is an item to be reviewed under topic I.14-3, Preservice Testing, which is to be addressed in a subsequent report on System Protection Features.

The pressurization system has a design basis requirement to maintain pressure for three hours. The system is sized at a flow of 350 cfm, which is over three times the calculated leakage rate from the control room. Subsequent to the three-hour period, self-contained breathing devices are utilized if external air is not available. The availability of such breathing devices is an operational requirement and does not represent a design constraint. No review specific to the availability of the devices was conducted.

Observations B-057 and B-067 were issued for this topic. The first dealt with a number transposition error in a calculation; however, the error was in an early portion of the calculation which was later superseded in the same calculation. No use was made of that portion of the calculation which contained the error. The second Observation dealt with inconsistencies in FSAR statements. In one FSAR section it was stated that the pressure in the control room was 1/4-inch water and in another section a range, 1/8-inch water to 1/4-inch water, was

given. The review of this topic was based on the more limiting 1/4-inch pressure and it was confirmed that that commitment was met.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. A review of the P&ID, calculations, drawings and specifications, indicates that the project has adequately considered the aspect of the design covered by this topic.

4.2.2.6 VENTILATION -- TOPIC I.35-3

The ventilation topic addresses the overall ventilation system design, the aspect of the design dealing with maintenance of temperatures, oxygen level, and airborne contaminants. This topic was very closely integrated with other topics because of the close interface of the design aspects. The scope of review included all five levels of review indicated on the matrix.

The overall design of the ventilation function was assessed through a review of the P&ID. That review and the FSAR commitments established the design considerations for this topic as well as the interfaces with other review topics. A summary of the major interfaces follows:

> **Temperature Control:** The system operating limits topic (Section 4.2.1.1) established the temperature and humidity conditions to be maintained for accident and normal conditions, as well as the outside conditions and surrounding space conditions. Heating/cooling requirements (Section 4.2.3) covered the development of heating and cooling loads.
>
> **Airborne Radiation:** The filtration topic (Section 4.2.3.4) addresses the removal of airborne radiological hazards.
>
> **Toxic Gases:** The identification of toxic gases and the setpoints for detection are addressed under Accident Considerations (4.1.2) and Component Functional Requirements (4.2.1.2).

The aspects separately addressed under the ventilation topic were oxygen level and hazardous gas concentrations.

SRP section 6.4 provides a discussion of the issue of oxygen content for sustained isolation. The general conclusion implied in the SRP is that oxygen level is not an issue, because control rooms are in general large enough to provide sufficient oxygen for long durations of isolation without replenishment systems. The SRP states, for example, that a 100,000 ft^3 control room could sustain a five-day isolation with seven people. The Midland FSAR commits to this five-day/seven-man standard even though there is no requirement to remain isolated for that period. The IDVP considers this to be a licensing commitment which is somewhat arbitrary but in any situation conservative. The Midland control room has a volume greater than 80,000 ft^3. In lieu of identifying and reviewing the calculation performed by the project, an independent calculation was performed. That calculation addressed the peak carbon dioxide level which is typically the parameter used to examine adequacy of air supply for breathing. The carbon dioxide level was calculated to be well below one percent. The ASHRAE Handbook establishes this as adequate for working environments, although a half percent is preferred from a comfort standpoint. It was the judgment of the IDVP that the control room size was adequate to satisfy the licensing commitment, particularly considering the fact that self-contained breathing devices are provided, and intended for use after 3 hours.

The concentrations of toxic gases within the control room was the subject of the most extensive review within this topic. The basis for limiting buildup following a postulated release is early detection and isolation, followed by a three-hour pressurized period. Subsequent to the three-hour isolation infiltration of small amounts of outside air would occur as pressurization was lost. The same system used to detect and isolate on high toxic concentrations outside the control room would monitor concentrations inside the control room and provide data to enable the personnel to know when the breathing devices would be required. This later scenario would only occur for a continuous release accident which could not be terminated in three or more hours. It is also noted that the pressurization system would very likely maintain pressure well beyond the three-hour commitment.

The most critical period in a toxic gas release scenario is the early detection and isolation for sudden increases in concentrations outside the control room. Concentrations are limited to FSAR values inside the control room which are considered conservative for short-term exposure, because the data on which the limits are based is for longer duration exposures. The approach taken was to calculate the time history of each chemical concentration outside the control room based on the methods established in Regulatory Guide 1.78, then to use that time history to calculate concentrations inside the control room by modeling the HVAC system behavior. The analysis is simplified by assuming uniform concentration inside the control room. The concentration outside of the control room at which the control room must be isolated to limit the concentration below the toxicity limit is predicted from the analysis. In setting these objectives for the toxic gas concentration at which the isolation is initiated this analysis used toxicity limits which were substantially below the FSAR values. The details of this approach were reviewed and found to be acceptable with one exception. The short-term concentrations in the initial stages of the buildup could be locally higher at the outlets of the HVAC distribution supply air ducts. To assess this an independent confirmatory analysis was performed.

The model for the confirmatory analysis did not presume that the concentrations of toxic gases were uniform throughout the control room. In the brief period (less than 6 seconds) between detection of a toxic substance and isolation of the incoming air the highest local concentrations occur. The confirmatory analysis utilized the Bechtel calculation for the concentration outside the control room at the intake. By using a simple model to determine dilution associated with the HVAC system recirculation and the smaller make-up supply a concentration at the supply duct was predicted. This was further diluted due to local mixing by the supply air diffuser.

That analysis indicated that concentration could be substantially higher than the average values predicted by the Bechtel model. This was the subject of Confirmed Item C-084. That OCR was resolved without Finding, because the resulting concentrations were found to be lower than values at which adverse effects would be anticipated. This fact was a result of the added conservatism

used in setting the limits in the Bechtel calculation, thereby offsetting the lack of conservatism in the assumption that toxic gas concentrations could be averaged throughout the control room. It is noted that only substances capable of toxic physiological effects in very short periods are of any concern. At the levels potentially present at Midland very few chemicals are a concern.

Observation O-128 dealt with minor differences in the pressure drop model used to calculate required fan parameters. The technical effect was negligible, because the resulting fan parameters were insignificantly different.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. The aspect of design covered by this topic was adequately interfaced with other aspects; it met the required criteria and therefore it is assessed to be adequately addressed in the design.

4.2.3 ELECTRICAL, INSTRUMENTATION, AND CONTROL EVALUATION

4.2.3.1 POWER SUPPLIES -- TOPIC I.15-3

The electrical design aspects related to the separation, redundancy, and independence of the power supply for components in the CR-HVAC system were reviewed under this topic. Criteria and commitments from the FSAR and implementing documents were reviewed. The electrical schematic diagrams were considered implementing documents as used for this topic. The focus of the review was to evaluate the quality of the power supplies (independence and redundancy) as input to the single failure analysis discussed in Section 4.1.3.

The review of the power supply for the CR-HVAC system is supplemental to the review of this topic covered under the AFW system and standby electric power (SEP) system reviews. Criteria and commitments are identified in the FSAR. These are common to all three systems with one major exception -- the design for station blackout, which is discussed below. The other aspects of the criteria were reviewed and found to be acceptable. Implementation of independence

criteria for redundant components was reviewed by checking the electrical schematic diagrams to ensure that redundant instrumentation existed, that they were independent, and were powered by separate power sources. Physical separation was not included in the review, because the overall assessment in that area could be made utilizing reviews for the AFW and SEP systems. The independence of power supplies for redundant components was reviewed against GDC-17 and Regulatory Guide 1.6. Redundant components were defined from the single-failure review. Overall, approximately 50 components were checked and all were found acceptable.

Station blackout design is a system specific issue. There is no FSAR commitment for CR-HVAC performance during station blackout. As such no review of power supply for the blackout condition was provided. The adequacy of the criteria, i.e., not explicitly addressing station blackout for the CR-HVAC design, was the subject of Confirmed Item C-074. The general issue of design for station blackout is currently under review as a regulatory issue and need not be independently addressed here. The item was raised first to determine if the licensing commitments were being correctly documented and then to assess in general the sensitivity of the design to the issue. The first question was answered by concluding that the FSAR correctly reflected the intent to not include station blackout as a design condition. The assessment of the second item was made after reviewing aspects of an existing Bechtel calculation. The calculation determined peak temperature after a 2-hour blackout (the length of the postulated condition in the FSAR). The IDVP review showed that the sensitivity of the design had been considered and that the temperatures in the control room would be acceptable at the end of a two-hour period without CR-HVAC. The system is also not required to provide any other function during blackout.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. Implementation through use of electrical schematic diagrams was reviewed and determined to be adequate. The interface between power supply and single failure was addressed by integrating these topics in the review and found to be adequate.

4.2.3.2 INSTRUMENTATION/DETECTION -- TOPIC I.18-3

Instrumentation utilized to monitor the status of the system and to monitor both the condition of incoming air and the control room condition was reviewed under this topic. The FSAR was reviewed as a criteria document, and the P&ID was reviewed as an implementing document. Design documents used in the review included the instrument index, material requisitions, instrument loop diagrams, and component schematics for dampers.

The control room instrumentation associated with monitoring system status and inside and outside conditions was reviewed in its entirety.

The instrumentation/detection evaluation consisted of a review of the quality of the components used for input to the CRIS for detection of high radiation and hazardous gas as well as the components used for CR-HVAC instrument loops. Position indication and status (not bypassed, bypassed) indication for control room isolation valves (dampers) were checked for compliance with GDC-13, Regulatory Guide 1.47.

The design requirements for instrumentation were identifed and compared to the FSAR commitments. The FSAR project commitments in the area of radiation detection and hazardous gas monitoring were compared to the CR-HVAC system P&ID, instrument index and the material requisitions for the radiation monitoring and hazardous gas monitoring systems. The monitoring of system flows, control room differential pressure and temperature, and CR-HVAC air temperatures was verified by inspection of CR-HVAC instrument logic diagrams, the instrument index, and the system P&ID. The isolation damper position and status indication (GDC-13 and Reg. Guide 1.47) was verified by inspection of the component schematic diagrams.

The major instrument procurement package and electronic field transmitter specifications used to procure AFW instrumentation were also used for the majority of instruments for the CR-HVAC system. It was previously determined as part of the AFW system review that these components were procured to the

appropriate codes and standards for Class IE equipment. Various CR-HVAC instruments were verified to have been procured using these specifications.

The HGMS was subjected to a comprehensive review which also involved other review topics. For a discussion of the review covering the calculation of setpoints for toxic gas concentration limits see Section 4.2.3.6.

The HGMS is a unique instrument system, because no similar designs are in use at other nuclear power plants. The Bendix Corporation was contracted to develop the HGMS technology. Because the technology required development, CPC submitted a specification which was functional instead of prescriptive. The IDVP focused on the adequacy of that functional description with respect to meeting FSAR commitments and satisfying the requirements imposed by the assumptions made in the calculations. To determine the adequacy of the HGMS performance, the test program results will be reviewed under Topic I.14-3, Preservice Testing.

OCR B-061, which related to this topic, was issued early in the system review and dispositioned as an Observation. It dealt with a very minor inconsistency on the P&ID. Electrical panels were numbered in two ways, OC 020 and OC 20. Having completed the review, that item can now be assessed as inconsequential with no potential for affecting the technical quality of the design.

The review of this topic is considered complete. The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. The implementation was reviewed in conjunction with control systems by reviewing the P&ID, instrument index, material requisition, component schematic diagrams, and instrument loop diagrams. That review confirmed that the criteria and commitments were properly and consistently implemented. It is concluded that this topic has been considered in the design of the CR-HVAC system in a satisfactory manner.

4.2.3.3 CONTROL SYSTEMS TOPIC I.19-3

The instrumentation control features, including permissives and inhibits were reviewed under this topic in conjunction with the instrumentation/detection review discussed in Section 4.2.4.2. The scope of review included criteria and commitments, implementing documents, and drawings.

The control room pressure control loop was chosen as being representative of the CR-HVAC design philosophy. The logic and schematic diagram control features were not reviewed for CR-HVAC components performing the control room isolation and the air handling and recirculation functions.

The controls review included a check of component schematic diagrams against their associated logic diagrams and the FSAR component operating descriptions in Section 9.4.1.2.3. Compliance to the requirements of GDC-13 and Regulatory Guide 1.106, Thermal Overload Protection for Electric Motors, was checked. In addition, the control room pressurization control loop was checked for quality of components and loop design (component selection).

The quality of components in the control room pressurization control loop was checked by verifying the applicability of the major instrument procurement package to the loop components. The major instrument procurement package used to procure AFW instrumentation was also used for the control loop components for the CR-HVAC system. It was previously determined as part of the AFW system review that these components were procured to the appropriate codes, standards, and requirements for Class 1E components.

In the process of reviewing HVAC duct layout drawings for the mechanical review topics, Confirmed Item C-145 was issued. That OCR dealt with the physical location of sensors for various types of instrumentation. On the HVAC duct layout drawings, the locations were inconsistent with the P&ID. These inconsistencies have been determined to be of no technical consequence, because the instruments would still function as required. The concern regarding the

implication of the errors as it relates to control of design documents, will be dispositioned in a subsequent report, which covers the IDVP Integrated Assessment.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. A review of the P&ID, logic and schematic diagrams, and loop diagrams, indicates that the criteria and commitments were properly and consistently implemented.

4.2.3.4 ACTUATION SYSTEMS AND SYSTEM ALIGNMENT AND SWITCHOVER -- TOPICS I.20-3 AND I.5-3

The actuation system for the CR-HVAC system is the safety-related actuation of the CRIS subset of the engineered safety features actuation system (ESFAS). The ESFAS design features were thoroughly reviewed in the evaluation of the AFW system; therefore, the design requirements particular to the CRIS subset were identified and reviewed. The scope of the review included criteria and commitments, implementing documents, evaluations, drawings and specifications. The system design for the CR-HVAC system is such that system alignment and switchover for safety-related operation is essentially the same design aspect as syster actuation. The scope described for the system actuation review is more extensive than that for system alignment/switchover, therefore the latter topic is completely enveloped by the former.

During all normal plant conditions the control room HVAC system is normally operating in an alignment which provides makeup air flow from outside the control room envelope. It is the function of the actuation system to change that alignment by sending signals to dampers and other components which realign the system for an isolated configuration. The control room pressurization system is also actuated by a CRIS which is essentially a valve actuation function. The other safety-related alignment is post-isolation which occurs at least three hours after isolation. This alignment is manually initiated if a permissive exists from the CRIS. This capability was reviewed as part of the control system review.

The design requirements particular to the CRIS and not included in the ESFAS, were identified and reviewed. The separate material requisition for the ESFAS was reviewed as was the Midland FSAR to ensure that the design requirements had been implemented. The CRIS actuation signals were traced from the CRIS logic diagram to the balance of plant (BOP)-ESFAS schematic diagram and to the component schematic diagrams. The component logic diagrams were also reviewed. All CRIS actuations were reviewed and the resultant alignment/ switchover completely checked.

The ESFAS material requisition contains requirements specific for the CRIS subsystem. Those requirements include a typical one-of-four coincidence logic for actuation upon receipt of high radiation, toxic gas or a main steam line isolation signal. The implementation of that logic was reviewed and was found acceptable.

The CRIS material requisition agrees with the logic diagram, and the actuations indicated on the logic diagram agree with FSAR commitments, and the CR-HVAC component logic and schematic diagrams. The CRIS logic interfaces with the component logic diagrams, and the review confirmed that the schematic diagram properly interfaces with the component schematic diagrams, i.e., the component logic and schematic diagrams are in agreement regarding actuation features.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. The review further determined that the CR-HVAC is actuated by a safety-related system which properly isolates the control room and switches the system alignment over to the mode necessary to maintain a habitable control room environment. The design requirements have been properly implemented into design documents, specifications and drawings.

4.2.3.5 SYSTEM ISOLATION/INTERLOCKS -- TOPIC I.7-3

System isolation was a subset of the design aspects associated with the CR-HVAC actuation system which is discussed in Section 4.3.4. Interlocks are a design aspect related to prohibit and permissive controls which establish the correct interaction between the status of components in the system. This design aspect overlaps with the control system topic for the HVAC system. To establish a boundary for each review, an interlock was defined as a permissive or inhibit which occurred from one drawing to another. The scope included review of criteria and commitments, implementing documents, evaluations and drawings.

The system isolation/interlock review is related to the previous reviews in that the intent of CR-HVAC actuation (CRIS) is to switch over the alignment of the system to an isolated state to prohibit the introduction of high radiation or hazardous gas into the control room. Isolation was verified by review of the actuated equipment and the system P&ID. Interlocks were identified and verified to permit proper system operation. Inhibits and permissives within a drawing were reviewed under control systems.

Component schematics were reviewed for consistency with the system P&ID, the component logic diagram, and the FSAR requirements.

All interlocks were identified and reviewed. For example, the air handling unit fan OVM-01A, -01B was required to be running for the recirculation fan OVV-03A, -03B to start, and air handling unit fan OVM-01A, -01B was required to be running for the makeup air supply fan OVV-66 A, -66B to start.

The criteria and commitments for this topic were found to be complete, consistent, and sufficiently detailed to allow implementation. From the review of systems level documentation (FSAR and P&ID) and component schematics, it is concluded that the design aspect covered by this topic is adequately addressed in the design.

5.0 REVIEW RESULTS

As discussed in Section 4.0, the Independent Design Verification Program (IDVP) review of the Control Room HVAC (CR-HVAC) system resulted in the preparation and subsequent resolution of Confirmed Items; however, the disposition of these Confirmed Items did not result in any Findings. Observations were also issued. Table 5-1 summarizes the final status of OCRs. Table 5-2 breaks down the summary information by review topic. All but two of the OCRs prepared by the Independent Design and Construction Verification (IDCVP) for the review scope covered by this report have been resolved. The resolved Open Items indicated in the table are items which were resolved internally within the IDCVP in accordance with the Project Quality Assurance Plan (PQAP).

5.1 EVALUATION OF CONFIRMED ITEMS AND OBSERVATIONS

The PQAP specifies that Confirmed Items are apparent errors in the design and that Findings are verified errors in design. Observations are minor discrepancies which do not constitute design errors, but which the IDCVP project team recommends correction or further review by Consumers Power Company (CPC) or Bechtel, even though they are not significant enough to warrant further review within the IDCVP. Although resolved Confirmed Items and Observations are not design errors, it is worthwhile to summarize the significance of these items.

Many of the Confirmed Items resulted from the lack of specific project design criteria documents and inconsistencies among project documents. The lack of design criteria resulted in OCRs such as C-066, C-073, and C-075. Had the assumptions and design bases been clearly specified, the concerns discussed in those OCRs may not have existed.

The lack of centralized design criteria documents may lead to potential conflicts among project documents, because it is not always clear which document is controlling. Midland, like many other plants, attempts to use the Final Safety Analysis Report (FSAR) as a criteria document; however, the FSAR also serves

TABLE 5-1

SUMMARY OCR STATUS

STATUS	NUMBER
Confirmed Items*	2
Resolved Open Items	4
Resolved Confirmed Items	8
Findings	0
Observations	8
Total	22

* Further review is required for final disposition of the Confirmed Items which are outstanding at the time of this report.

TABLE 5-2

OCR STATUS BY TOPIC

Topic Number	Topic Title	OCR[2] No.	Status[1]
I.1-3	System Operating Limits	060	O/R
		074	C/R
		075	C/R
I.2-3	Acc. Anal. Consid.	None	
		083	O/R
		084	C/R
		126	OBS
I.3-3	Single Failure	097	C/R
I.5-3	System Alignment/Switchover	066	C/R
I.7-3	System Isolation/Interlocks	None	
I.9-3	Comp. Func. Req.	082	O/R
		127	OBS
		129	C/R
		167	OBS
		173	OBS
I.10-3	System Pneumatic Design	None	
I-12-3	Cooling/Heating Requirements	058	O/R
		073	C/R
		076	C/R
I.15-3	Power Supplies	None	
I.18-3	Instrumentation	061	OBS
I.19-3	Control Systems	145[3]	
I.20-3	Actuation systems	None	
I.23-3	Failure Modes and Effects	None	
I.33-3	Filtration	None	
I-34-3	Pressurization	057	OBS
		067	OBS
I.35-3	Ventilation	128	OBS

[1] Status Categories:
O/R = Opened and subsequently Resolved
C/R = Confirmed and subsequently Resolved
F/R = Resolved Finding
OBS = Observation

[2] Where an OCR is related to two or more topics, it is listed in the table based upon the first topic number identified for the OCR in the monthly OCR tracking system summary table.

[3] Confirmed items C-085, which applies to all topics, and C-145 address concerns for process-related issues which will be included in the Integrated Assessment report.

to summarize project analyses, including analyses requested by the Nuclear Regulatory Commission (NRC). After multiple amendments, it is difficult to determine whether a statement in the FSAR is a design basis for the plant or an assumption used for a special analysis. The Confirmed Items associated with a lack of centralized design criteria did not, however, lead to any Findings. This would support a conclusion that the FSAR was adequate as a criteria document. However, most of the criteria for the heating, ventilating and air conditioning (HVAC) system are not complex and are very similar from plant to plant.

The lack of documentation for certain analyses such as failure modes and effects analyses and single-failure analyses was noted as an Observation in the auxiliary feedwater (AFW) system review. Similarly, such documentation was not available for the control room heating, ventilating, and air conditioning (CR-HVAC) system. The evaluation performed by the IDVP led to Confirmed Item C-097. The concern was resolved without becoming a Finding.

A number of the Observations resulted from minor errors in calculations which did not effect the actual design, but which could have been found in the normal checking process applied to safety-related calculations. The IDVP project team is reviewing additional Bechtel calculations as part of the remaining IDVP scope. The conclusion of those reviews and this review will be used in reaching overall conclusions regarding the general adequacy of calculations.

5.2 ONGOING ACTIVITIES

The IDVCP evaluated all Observations and Confirmed Items for generic implications. While the Observations and Confirmed Items in general did not individually warrant additional review, collectively two potential causes of many of these inconsistencies were identified during the CR-HVAC review. Potential causes under investigation are the lack of centralized design criteria documents and calculation control procedure implementation. As discussed in Section 5.1 the CR-HVAC review, by itself, does not provide conclusive information regarding the former. The concern regarding calculation control was the subject of Confirmed Item C-085 which is yet to be resolved. Additionally, inconsisten-

cies between interfacing drawings were noted in Confirmed Item C-145 which is also outstanding. The disposition of these two OCRs will provide information useful in evaluating the general concern regarding documentation control and its impact on the design process. A subsequent IDVP report will address that evaluation.

5.3 CONCLUSIONS

Based upon the IDCVP review and independent confirmatory evaluations, it is concluded for areas within the scope of this report that confidence exists that the CR-HVAC system will perform its intended safety functions. The remaining two Confirmed Items, C-085 and C-145 may have a bearing on the extent to which the CR-HVAC results can be extrapolated to the plant in general, but they have no impact on the confidence in the CR-HVAC design.

APPENDIX A

CPC COMMENTS ON REPORT

(TO BE INCORPORATED IN THE
FINAL VERSION OF THE REPORT)

APPENDIX B
CONSOLIDATED CRITERIA AND COMMITMENTS

CONTROL ROOM HVAC
CONSOLIDATED CRITERIA AND COMMITMENTS

Description

The FSAR was reviewed to identify stated criteria and design bases. Additionally, Table 1 entitled, "Midland Control Room HVAC GDC and Regulatory Guide Applicability," lists GDC and Reg. Guides which also apply. These listings will be used as input to evaluate the adequacy of the criteria and design bases, and to conduct the remaining review. Source references for each criterion listed below refer to page numbers in the FSAR.

Stated Criteria and Commitments and Design Bases

1. The radiation exposure of control room personnel through the duration of any one of the postulated design basis accidents discussed in Chapter 15 does not exceed the guidelines set by 10 CFR 50, Appendix A, General Design Criterion 19; i.e., personnel exposures are limited to 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.

   Source: page 9.4-1 Discipline: Mechanical

   Topic Numbers: I.1-3, I.10-3, I.33-3, I.34-3, I.35-3

2. Through the duration of any one of the design basis accidents discussed in Chapter 15, the control room HVAC system maintains the control room atmosphere at temperatures suitable for prolonged occupancy.

   Source: page 9.4-1 Discipline: Mechanical

   Topic Number: I.1-3

3. Control room personnel are protected from prolonged exposure to chlorine, hazardous chemicals, and products of combustion.

   Source: page 9.4-1 Discipline: Mechanical

   Topic Numbers: I.33-3, I.34-3, I.35-3

4. The failure of an active component of the control room HVAC system, assuming a loss of offsite power, cannot impair the system's ability to meet criteria 1, 2, and 3.

   Source: page 9.4-2 Discipline: Mechanical/Electrical

   Topic Number: I.3-3, I.23-3

5. The failure of any single active component of the control room pressurization system, assuming a loss of offsite power, cannot impair the system's ability to meet criteria 1 and 3. (Note: the FSAR does not explicitly include Criterion 3, but it is clear that it should be included.)

   Source: page 9.4-2 Discipline: Mechanical/Electrical

   Topic Number: I.3-3, I.23-3

6. The control room HVAC system and the control room pressurization system are designed to remain functional during and after a safe shutdown earthquake. This criterion has two parts:

   a. The control room HVAC system and the control room pressurization system are designed in accordance with Seismic Category I requirements.

   b. The components (and supporting structures) of any system, equipment, or structure which is not Seismic Category I and whose collapse could result in loss of a required function through either impact or flooding cannot collapse when subjected to seismic loading.

   Source: pages 9.4-2, 9.4-9, and 9.4-10 Discipline: Mechanical/Structural

   Topic Number: II.1-3

7. During normal operation, the control room HVAC system is designed to maintain a positive pressure in the control room and a dry bulb temperature within the comfort zone recommended in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Comfort Standard 55-74 (see Figure 16 on page 8.21 of ASHRAE 1981 Fundamentals Handbook).

   Source: page 9.4-2 Discipline: Mechanical

   Topic Numbers: I.34-3, I.1-3, I.12-3

8. The control room air purification system and shielding designs are based on the most limiting design basis assumptions, those of Regulatory Guide 1.4.

   Source: page 9.4-8a Discipline: Mechanical

   Topic Number: I.33-3

9. The control room volume contains sufficient oxygen to maintain an emergency team of seven men for five days after a radiological accident.

   Source: page 6.4-2 Discipline: Mechanical

Topic Number: I.1-3

10. The makeup air pressurization equipment and self-contained breathing apparatus provide a nine-hour air supply for the same team during a toxic gas incident.

Source: page 6.4-2 Discipline: Mechanical

Topic Number: I.1-3

11. Exfiltration and infiltration are determined in accordance with NAA-SR-10100, Conventional Buildings for Reactor Containment, June 1965, Atomics International; and Regulatory Guide 1.78 (June 1974).

Source: page 6.4-2a Discipline: Mechanical

Topic Numbers: I.34-3, I.35-3

12. Doors connecting the control room with the turbine room are designed to withstand the maximum calculated effects of pipe whip, steam flooding, fluid jet impingement, and turbine building pressurization.

Source: page 6.4-4 Discipline: Mechanical/Structural

Topic Number: II.5-3

13. The toxic gas monitors will activate an alarm to alert the control room operator of the presence of toxic chemicals.

Source: page 6.4-7 Discipline: Electrical

14. High efficiency particulate air (HEPA) filters are manufactured and tested prior to installation in accordance with MIL-F-51068 and MIL-F-51079 as modified by NRC Health and Safety Information Bulletins 306 and 334 respectively.

Source: page 6.4-9 Discipline: Mechanical

Topic Number: I.33-3

15. The carbon adsorber has qualification and batch tests performed in accordance with Regulatory Guide 1.52.

Source: page 6.4-9 Discipline: Mechanical

Topic Number: I.14-3

16. After installation, HEPA filters and carbon adsorbers are tested in accordance with ANSI N510, Testing of Nuclear Air-Cleaning Systems.

Source: page 6.4-10 Discipline: Mechanical

Topic Number: I.14-3

17. The control room ventilation system will undergo acceptance tests to verify the system will maintain a positive pressure in the control room.

Source: page 6.4-10 Discipline: Mechanical

Topic Number: I.14-3

18. Inservice testing of the control room area ventilation system is conducted in accordance with the surveillance requirements given in the plant Technical Specifications, Chapter 16.

Source: page 6.4-10 Discipline: Mechanical

Topic Number: I.14-3

19. The following classification of structures, components, and systems applies:

System/Component	FSAR Section	Quality Group	Design Code/ Standard	Seismic Category
Auxiliary Building	3.8.4	NA	ACI-318, AISC, AWS D1.1	I
ESFAS	7.3.3	NA	IEEE-279	I
Shutdown Monitoring	7.5	NA	IEEE-279	I
Accident Monitoring	7.5	NA	RG 1.97	--
Other I&C Required for Safety	7.6	NA	IEEE-279	I
Power Systems	(see SEP review area)			
Control Room HVAC System	9.4.1			
Supply and Recirculation				
Motors		NA	IEEE-344	I
Fans (5)		NA	NA	I
Cooling coils		C	III-3	I
Heating coils		NA	NA	I
Ductwork		NA	SMACNA	I
Dampers		NA	ANSI N509	I
Damper actuators		NA	IEEE-323/344/ 383/384	I
Isolation damper actuators		NA	IEEE-323/344/382	I
Filtration				
Motors		NA	IEEE-323/334/344	I
Fans		NA	AMCA	I
Prefilters		NA	UL Class 1	I
HEPA filters		NA	HSI-306, MIL-F-59068D	I
Carbon adsorber		NA	CS-8T	I
Electric heater		NA	IEEE-344/323	I
Ductwork		NA	SMACNA	I
Dampers		NA	ANSI N509	I
Damper actuators		NA	IEEE-323/344/ 383/384	I
Normal smoke exhaust				
Motors		NA	NEMA MG-1	NA
Fans		NA	AMCA	NA
Ductwork		NA	SMACNA	NA
Dampers		NA	ANSI N509	NA

Pressurization system			
Tank	C	ASME III-3	I
Piping and valves	C	ASME III-3	I

Source: Table 3.2-1 Discipline: All

Topic Numbers: II.2-3, II.3-3, II.4-3

20. Design provisions for external flooding are provided in accordance with Regulatory Guide 1.59 (Rev. 2, 8/77), except removable water-tight barriers are used where permanent protection is not feasible.

Source: page 3A-89 Discipline: Structural

Topic Number: III.5-3

21. Piping, mechanical components, electrical components, actuation equipment, and HVAC components are protected from the consequences of postulated failures that could cause flooding. The following assumptions apply:

a. Failures in moderate energy piping systems, outside of the containment, are postulated in accordance with Branch Technical Position MEB 3-1. High energy piping system failures are postulated as discussed in FSAR Section 3.6.

b. Post-LOCA passive failures are limited to critical cracks in piping, sprung flanges, leaking packing, seals, and the like.

c. A 10-minute delay is assumed for those situations that involve operator action in the control room.

d. An additional 30-minute delay is assumed for those situations that involve operator action at a location not immediately adjacent to the control room or some other continuously manned area.

e. Full area breaks will be assumed in all high energy lines if the fraction of the time the system operates at high energy conditions is greater than 2% of the time the system is not under high energy conditions and in the auxiliary feedwater system.

f. Circumferential cracks (equivalent to a circular orifice whose area equals 1/4 x pipe wall thickness x the inside diameter) will be assumed in all high energy lines not covered by e) above.

g. The postulated failures shall be considered to occur individually.

h. Concurrent with a passive failure, an active failure will be taken in any of the systems required for the safe shutdown of the plant or to mitigate the consequences of the flooding. Single-failure criteria are applied in accordance with NRC Branch Technical Position MEB 3-1.

i. Where redundant systems exist, a loss of redundancy is permitted but a loss of function is not.

j. Accumulated water in low-level compartments will be removed by the compartment drainage system. However, the drains are open only when actuated and no credit for drainage was taken in the flooding analysis.

Source: page 3.4-4 Discipline: Mechanical

Topic Number: II.10-3

22. Missile protection and HELB criteria are generic to all three systems which are a part of the IDVP (see AFW review for criteria).

Topic Number: II.13-3

23. The criteria for seismic design of HVAC ducts are not stated separately; however, they are contained in the criteria for "seismic subsystems" and are distinguished from piping. A summary follows:

a. The response spectrum method of analysis using modal superposition per Section 4.2.1 of BC-TOP-4-A is used if static coefficient methods cannot be justified.

b. Exception is taken to Regulatory Guide 1.92 regarding modal superposition (see FSAR Appendix 3A).

c. Analytical modeling for dynamic analysis is per Sections 3.2 and 5.0 of BC-TOP-4-A.

d. Static equivalent methods are used if the first mode frequency is greater than 33 Hz. If the subsystem is dynamically simple, it is modeled as a single-degree-of-freedom system. The fundamental frequency is calculated and the subsystem is designed to the applicable modified response spectrum acceleration corresponding to the calculated frequency. Alternatively, if the fundamental frequency is not calculated, the subsystem is conservatively qualified for the peak acceleration of the applicable response spectra.

If the subsystem is a frame type structure too complex to be simulated as a single-degree-of-freedom system, the subsystem is designed to the applicable response spectra accelerations from the modified spectral curves (multiplied by 1.5) corresponding to the calculated frequency. The response spectra used for this method are the modified response spectra

shown in Figure 3D-1 of the FSAR.

Alternatively, if the fundamental frequency is not calculated, the subsystem may be conservatively designed for the peak acceleration of the applicable response spectra multiplied by 1.5. The 1.5 factor accounts for the multi-mode effects.

e. Section 5.3 of BC-TOP-4-A describes the approaches used for multiply-supported subsystems.

f. Constant vertical load factors are applied only to subsystems that can be categorized as rigid, i.e., a frequency greater than 33 Hz.

g. Analysis procedures for the determination of composite modal damping values in a response analysis of seismic subsystems are in accordance with Sections 3.2 and 3.3 of BC-TOP-4-A.

Topic Numbers: II.1-3, II.3-3

24. Stress limits, applicable codes and standards, and qualification methods for mechanical components of the HVAC system are identified in Table 3.9-1, sheets 24 through 28.

Topic Numbers: II.2-3, II.3-3

25. A 1/4" w.g. pressure differential is maintained by the pressurization system for 3 hours.

Source: page 6.4-7

Topic Number: I.34-3

26. Carbon adsorber temperature is alarmed in the control room at 165 degrees F.

Source: page 9.4-8

Topic Number: I.18-3

27. During post-accident operation, the control room is maintained at 75 degrees F during any portion of the year.

Source: page 9.4-8a

Topic Number: I.1-3, I.12-3

28. The primary means of notification of a chemical release is by dedicated telephone. (Note that the system design takes no credit for operator action associated with such notification.)

Source: page 6.4-1

Topic Number: I.2-3

29. Toxic gas protection analysis assumes an inleakage of 82 cfm. Calculated inleakage is 62.45 cfm @ 1/8 w.g. pressure differential.

Source: page 6.4-3

Topic Number: I.10-3

30. Pasquill stability F is used for meteorological conditions.

Source: page 6.4-7

Topic Number: I.33-3

31. Wind speed of 4 M/S is used rather than 1 M/S.

Source: page 6.4-8

Topic Number: I.33-3

32. Nc credit is taken for operation of the charcoal filter during continuous release of toxic gases.

Source: page 6.4-8

Topic Number: I.33-3

33. Nitrogen storage containers stored on-site have an 8000 scf capacity and are 130 meters from the control room outside air intake.

Source: 6.4-8

Topic Number: I.2-3

34. Liquefied carbon dioxide is stored in one 13 ton and one 7 ton tank. Failure of the 13 ton tank is postulated.

Source: page 6.4-9

Topic Number: I.2-3

35. Meteorological data used to model toxic gas dispersion are tabulated in Table 2.2-6.

Topic Number: I.2-3

36. The toxic releases were modeled using the additional assumptions in the FSAR "a" through "i".

Source: page 2.2-17

Topic Number I.2-3

37. The following components should be sized as noted:

Component	Equip. Numbers*	Sizing	Quan. Reqd.
Supply/Recirculation Air Handling Units	OVM-Ø1 A&B	1ØØ%	2
Recirculation Air Filters	OVM-79 A&B	1ØØ%	2
Makeup Air Filters	OVA-78 A&B	1ØØ%	2
Makeup Air Supply Fans	OVV-66 A&B	1ØØ%	2
Control Room Smoke Removal Fans	OVV-65 A&B	1ØØ%	2
Pressurization Tanks	OVT-28 A&B	5Ø%	2

Source: page 9.4-3

Topic Number: I.9-3

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*Taken from P&ID M-465 SHI & 2(Q) Rev. 9. Listing indicates confirmation of the existence of equipment, not sizing.

38. Control room isolation, alignment/switchover, and actuation are in accordance with system operation defined in FSAR Section 9.4.1.2.3.

Source: page 9.4-4

Topic Number: I.5-3, I.7-3, I.20-3

39. Actuation of electrical components (e.g., dampers) is by CRIS channel in accordance with FSAR Table 7.3-3.

Source: Table 7.3-3

Topic Number: I.5-3, I.7-3, I.20-3

40. Instrumentation and control requirements are in accordance with FSAR Section 7.3.3.2.9.

Source: page 7.3-32

Topic Number: I.18-3, I.19-3

41. Electric power supply systems for CR-HVAC are required to meet the GDC-17 as amplified by Regulatory Guide 1.6.

Topic Number: I.15-3

ATTACHMENT A

MIDLAND CONTROL ROOM HVAC
GDC AND REGULATORY GUIDE APPLICABILITY

Compliance with GDC and Regulatory Guides (RG) is discussed in FSAR Section 3.1 and Appendix 3A, respectively. The GDC applicable to the Control Room (CR) HVAC can be categorized as either generically applicable to all plant design or specific to the CR HVAC as follows:

1.0 10CFR50 Appendix A, General Design Criteria (GDC)

Criterion Number	Title	Discipline	Topic No.
GENERIC			
1	Quality Standards and Records	All	All
2	Design Bases for Protection Against Natural Phenomena	Mech/ Struc	II.1-3 II.2-3 II.3-3 II.4-3 III.1-3 II.14-3
3	Fire Protection	Mech	II.12-3
4	Environmental and Missile Design Bases	Mech	II.5-3 II.8-3 II.13-3
5	Sharing of Structures, Systems, and Components	All	All
SPECIFIC			
19	Control Room	Mech	All I topics

2.0 Regulatory Guides

RG Number	Title	Discipline	Topic No.
GENERIC			
1.26 R3	Quality Group Classification	--	--
1.28[1] (6/7/72)	Quality Assurance Program Requirements	All	All
1.29 R3	Seismic Design Classification	Mech/ Struc	II.1-3 - II.4-3, III.1-3
1.48[3] (5/73)	Design Limits and Loading Combinations for Seismic Category I Fluid System Components	Mech	II.2-3, II.3-3, II.4-3
1.53[1] (6/73)	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems	Mech/ Elect	I.3-3
1.59[1] R2	Design Basis Floods for Nuclear Power Plants	Struc	III.5-3
1.60[1] R1	Design Response Spectra for Seismic Design of Nuclear Power Plants	Mech/ Struc	II.1-3, III.1-3
1.61[1] R0	Damping Values for Seismic Design of Nuclear Power Plants	Mech/ Struc	II.1-3, III.1-3
1.62[1] (10/73)	Manual Initiation of Protective Actions	Elect	I.20-3
1.64[1] R2	Quality Assurance Requirements for the Design of Nuclear Power Plants	All	All
1.76[1] (4/74)	Design Basis Tornado for Nuclear Power Plants	Struc	III.5-3
1.84[3] R19	Design and Fabrication Code Case Acceptability - ASME Section III Div. 1	Mech	II.2-3
1.85 R19	Materials Code Case Acceptability - ASME Section III Div. 1	Mech	I.22-3
1.89[1] (11/74)	Qualification of Class IE Equipment for Nuclear Power Plants	Mech	II.4-3, II.10-3
1.92[1] R1	Combining Modal Responses and Spatial Components in Seismic Response Analysis	Mech/ Struc	II.1-3, III.1-3
1.97 R2	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions	Elect	I.18-3

RG Number	Title	Discipline	Topic No.
1.100[2] R1	Seismic Qualification of Electric Equipment for Nuclear Power Plants	Mech/ Elect	II.4-3
1.102[1] R1	Flood Protection for Nuclear Power Plants	Struc	III.5-3
1.105[1] R1	Instrument Setpoints	Elect.	I.18-3
1.106[1] R1	Thermal Overload Protection for Electric Motors on Motor Operated Valves	Elect	I.19-3
1.115[2] R1	Protection Against Low-Trajectory Turbine Missiles	Mech	II.13-3
1.117[1] R1	Tornado Design Classification	Struc	III.5-3
1.120[1] R1	Fire Protection Guidelines for Nuclear Power Plants	Mech	II.12-3
1.122[1] R1	Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components	Mech	II.1-3
1.123[1] R1	Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants	All	All
1.142[1] R1	Safety-Related Concrete Structures for Nuclear Power Plants	Struc	III.5-3
1.148[1]	Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants	Mech	I.9-3
SPECIFIC			
1.4 R2	Assumptions Used for Evaluating the Potential Radiological Consequences of a LOCA	Mech	I.33-3
1.52 (6/73)	Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units	Mech	I.9-3
1.78 (6/74)	Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release	Mech	I.2-3
1.95 R1	Protection of Nuclear Power Plant Control Room Operators	Mech	I.2-3

NOTES:

[1]This Reg. Guide has no unique aspects which require a separate review of the FSAR position regarding compliance as discussed in FSAR Appendix 3A. This aspect of the criteria scope of review will utilize, directly, the AFW review.

[2]A review of the Reg Guide compliance was conducted, because there might have been aspects unique to the Control Room HVAC; but nothing unique was found. Therefore, the criteria scope of review will utilize, directly, the AFW review.

[3]Aspects of this Reg Guide are common to both AFW and the Control Room HVAC, others are unique to HVAC. (See the table entitled, "Midland IDVP-Control Room HVAC-Review of Mechanical Discipline Commitments in GDC and RGs.") Aspects common to AFW and HVAC will utilize the AFW review for the criteria scope of review.

ATTACHMENT B

CROSS REFERENCES BETWEEN TOPIC NUMBER,
CRITERIA AND COMMITMENTS

Review Topic Number	Criteria/ Commitment Numbers
I.1-3	1, 2, 7, 9, 10, 27
I.2-3	28, 33, 34, 35, 36
I.3-3	4, 5
I.5-3	38, 39
I.7-3	38, 39
I.9-3	37
I.10-3	1, 29
I.12-3	7, 27
I.15-3	41
I.18-3	26, 40
I.19-3	40
I.20-3	38, 39
I.23-3	4, 5
I.33-3	1, 2, 14, 30, 31, 32
I.34-3	1, 2, 7, 11, 25
I.35-3	1, 2, 11