REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8106110456 DOC.DATE: 81/06/08 NOTARIZED: NO DOCKET #
FACIL:50-244 Robert Emmet Ginna Nuclear Plant, Unit 1, Rochester G 05000244
AUTH.NAME AUTHOR AFFILIATION
MAIER,J.E. Rochester Gas & Electric Corp.
RECIP.NAME RECIPIENT AFFILIATION
CRUTCHFIELD,D. Operating Reactors Branch 5

SUBJECT: Forwards conceptual design info for emergency response facilities including instrumentation & data display sys,per Generic Ltr 81-10.Sys cannot be completed by 821001.Four oversize drawings encl.Aperture cards will be in PDR.
SEE DRAWINGS & Rpts

DISTRIBUTION CODE: A046S COPIES RECEIVED:LTR 1 ENCL 3 SIZE: 55+4
TITLE: Response to NUREG-0737/NUREG-0660 TMI Action Plan Rqmts (OL's)

NOTES:1 copy:SEP Sect. Ldr. 05000244

	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL
ACTION:	CRUTCHFIELD	05	7	7				
INTERNAL:	A/D C&C SYS	27	1	1	A/D C&S ENG	22	1	1
	A/D FOR TECH	32	1	1	A/D GEN PROJ	31	1	1
	A/D LICENS	16	1	1	A/D M&Q ENG	23	1	1
	A/D OP REACT	15	1	1	A/D PLANT SYS	25	1	1
	A/D RAD PROT	26	1	1	A/D SAFETY AS	17	1	1
	DEP DIR,DHFS	29	1	1	DIR,EM PREP	33	1	1
	DIRECTOR,DE	21	1	1	DIRECTOR,DHFS	28	1	1
	DIRECTOR,DL	14	1	1	DIRECTOR,DSI	24	1	1
	DIRECTOR,DST	30	1	1	EMERG PREP DEV		1	1
	I&E	12	2	2	OELD		1	0
	OR ASSESS BR	18	3	3	PDR	02	1	1
	RAD ASMT BR		1	1	REG FILE	01	1	1
EXTERNAL:	ACRS	34	16	16	INPO,J.STEARNS		1	1
	LPDR	03	1	1	NSIC	04	1	1

SEND DRWGS TO:

BC(2)

REG FILES

APERTURE DIST.

JUN 16 1981

TOTAL NUMBER OF COPIES REQUIRED: LTTR ~~53~~ 54 ENCL ~~52~~ 53

ROCHESTER GAS AND ELECTRIC CORPORATION • 89 EAST AVENUE, ROCHESTER, N.Y. 14649

JOHN E. MAIER
VICE PRESIDENT

TELEPHONE
AREA CODE 716 546-2700

June 8, 1981

Director of Nuclear Reactor Regulation
Attention: Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Emergency Response Facilities
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Crutchfield:

NRC Generic Letter 81-10 dated February 18, 1981, requested that we provide conceptual design information for the emergency response facilities including instrumentation and data display systems. Attachment 1 to this letter responds to the specific requests of the Generic Letter.

Three response facilities have been established, the operational support center (OSC), the technical support center (TSC), and the emergency operations facility (EOF). The OSC is located in the Turbine Building in the auxiliary operators office. The OSC has been previously described in our letter of December 28, 1979. The OSC has been completed.

The permanent TSC will be located near the control room in the second story of the condensate demineralizer (or AVT) building. This facility has previously been described in our letter of December 28, 1979 and is further described in Attachment 2. This facility is nearly ready for occupancy as the TSC.

A046
S
1/3

The EOF is located in the RG&E main offices. This facility has previously been described in the Nuclear Emergency Offsite Response Procedure which was transmitted by our letter to you dated February 27, 1981.

SEND DRAWINGS to BC (2) REG FILES

Since considerable effort has been expended in providing these facilities, NRC reviews of the OSC, TSC and EOF should be considered to be "post-implementation reviews" at this time, not pre-implementation reviews.

APERTURE DIST.

8106110456 F

Instrumentation and data displays are under development and are described in Attachment 1 to this letter. It should be noted that the complete data display systems cannot be implemented by October 1, 1982.

Very truly yours,

John E. Maier

J. E. Maier

Attachments

Attachment 1
Emergency Response Facilities
June 8, 1981

(1) Task functions of the individuals required to report to the TSC and EOF upon activation and for each emergency class.

Response: Details concerning the activation, staffing, and function of the TSC are provided in the Ginna Station Radiation Emergency Plan, submitted by letter dated December 30, 1980 and in procedure SC-1.3D "Manning the Technical Support Center" submitted by letter dated February 27, 1981.

Details concerning the activation, staffing and function of the EOF are provided in the Ginna Station Radiation Emergency Plan and in the "Nuclear Emergency Offsite Response Procedure" submitted by letter dated February 27, 1981.

(2) Descriptions of TSC instrumentation, instrument quality, instrument accuracy and reliability.

Response: The TSC instrumentation will consist primarily of CRT displays and interactive terminals communicating with the Safety Assessment System (SAS) and the plant Process Computer. The specification for the SAS is attached (Appendix 1). The availability/ reliability of these systems is also described in Appendix 1.

The instrument ranges used for display will encompass the ranges of those instruments existing in the control room or those which will be installed in the control room as a result of NUREG-0578 requirements. Display accuracy will be consistent with that of the control room instruments.

(3) Descriptions of TSC power supply systems, power supply quality, reliability and availability, and consequences of power supply interruption.

Response: The TSC power supply system is now in place and undergoing functional testing. Power to the data transmission and computer systems (including all components which would lose stored information or require a significant restart time as a consequence of a momentary power loss) are supplied from a highly reliable, uninterruptable power supply (UPS). This system is not Class IE or redundant. However, it is equipped with automatic transfer to a regulating transformer to

provide power continuity in the event of an inverter failure. The UPS batteries are sized to carry the loads for two hours. The battery charger has sufficient capacity to simultaneously supply the connected loads and recharge the battery. A dedicated standby diesel generator starts automatically and picks up the TSC loads in the event of a loss of offsite power. The diesel generator is not Class IE, but is highly reliable and sized to handle all TSC requirements.

(4) Descriptions of the design of the TSC data display systems, plant records and data available and record management systems.

Response: Terminals and associated displays will be provided in the TSC that permit personnel assigned there full access to the SAS and Plant Process Computer systems (with appropriate system software security), independent of all other terminals. At least one terminal will permit either direct or indirect access to offsite computer facilities by means of an offsite data link. On-line programming capability sufficient to permit limited direct analysis and evaluation will be available. These systems are described in detail in Appendix 1.

A records storage area is located in the TSC to provide direct access to data and technical information.

(5) Descriptions of the data transmission system to be installed between the TSC and control room.

Response: Data acquisition for the TSC will be independent of the control room. However, certain non safety related displays located in the control room may be driven from equipment located in the TSC. Appropriate isolation will be provided at all Class IE interfaces.

(6) Description of data to be provided to the EOF.

Response: Displays and terminals will be located in the EOF which are capable of accessing any SAS or Process Computer data.

APPENDIX I

SAFETY ASSESSMENT SYSTEM

FOR

PWR NUCLEAR POWER PLANTS

BY

INSTRUMENTATIONS SYSTEM COMMITTEE

FOR

ALABAMA POWER CORPORATION

COMMONWEALTH EDISON CORPORATION

CONSOLIDATED EDISON CORPORATION

FLORIDA POWER AND LIGHT COMPANY

ROCHESTER GAS AND ELECTRIC CORPORATION

WISCONSIN ELECTRIC POWER COMPANY

WISCONSIN PUBLIC SERVICE CORPORATION

NOVEMBER, 1980

TABLE OF CONTENTS

PART I - GENERAL REQUIREMENTS

		Page
1.0	Introduction	1
	1.1 Plant Description	1
	1.2 Summary Description of Computer System	2
	1.3 Expandability	3
	1.4 Definitions	3
2.0	General	
	2.1 Scope of Work - Contractor	4
	2.2 Scope of Work - Purchasers	6
	2.3 Schedules	7
	2.4 Changes	7
	2.5 Contractor's Guarantee and System Availability	8
	2.6 Subcontracted Work	8
	2.7 Specified Products and Substitutions	8
	2.8 Origin of Subsystems	8
	2.9 Cost Breakdown	9
	2.10 Additional Terms and Conditions	9
3.0	Additional Requirements	
	3.1 Standards	9
	3.2 Quality Assurance	9
	3.3 Factory Testing	10
	3.4 Equipment Packaging, Shipping, Storage	12
	3.5 Contractor's Drawings	13
	3.6 Contractor's Instruction Books, Manuals, Listings	15
	3.7 Purchaser's Training	18
	3.8 Spare Parts	18
	3.9 Installation	19
	3.10 Diagnostic Software	20
	3.11 Additional Proposal Data	22

PART II - SAFETY ASSESSMENT SYSTEM

1.0	General	24
2.0	Functional Requirements	
	2.1 Safety Assessment Functions	24
	2.2 Safety Assessment System	24
	2.2.1 Key Parameter Display	25
	2.2.2 Accident Identification and Display System	26
	2.2.3 Safety System Ready Monitor	27
	2.2.4 Accident Mitigation Monitor	27
	2.2.5 Critical Parameter Trending and Display	28
	2.3 Nuclear Data Link	29
	2.4 Push Button Function Panel	30
	2.5 Additional Safety Assessment System Functions	30

		Page
3.0	Technical Requirements	
	3.1 General	30
	3.2 Programming	32
	3.3 Memory Protection	33
	3.4 Operation	34
	3.5 System Functions	34
	3.5.1 Scanning	35
	3.5.2 Data Transfer to Plant Process Computer System	36
	3.5.3 Nuclear Data Link	36
	3.6 Field Multiplexors and Input Signal Racks	37
	3.7 Seismic Capability	42
	3.8 Availability	43
	3.9 Peripheral Requirements	46

FINAL
11-07-80

SAFETY ASSESSMENT SYSTEM
AND
PROCESS COMPUTER SYSTEM
COMMON REQUIREMENTS
FOR PWR NUCLEAR POWER PLANTS

PART I: GENERAL REQUIREMENTS

1.0 INTRODUCTION

Florida Power and Light Company, Northern States Power Company, Rochester Gas and Electric Corporation, Wisconsin Electric Power Company and Wisconsin Public Service Corporation invite proposals complying with this Specification for a computer system, related peripheral equipment and services. Delivery of the equipment is required as specified in the appropriate Appendices.

The following presents a Specification of common requirements for a computer system and related peripheral equipment by the aforementioned companies hereinafter referred to as Purchasers. Additional plant specific requirements and information is presented in the appendices hereto. Reference to the related plant specific appendices is denoted by a parenthesized number in the left hand margin of this common Specification. It is the intent of the Purchasers that, following selection of a successful bidder (Contractor), each company will purchase a computer system meeting the common requirements described below, appropriately modified in accordance with his plant specific requirements described in the respective appendices. However, a collective commitment by the Purchasers cannot be made prior to their respective reviews of Bidder's proposals. It is possible that one or more of the companies may, for reasons of their own, award the contract to an alternate Bidder.

1.1 Plant Description

Purchasers each own and operate a one or two-unit, pressurized water reactor nuclear plant as described in their related appendix.

The purpose of making this a joint request is so that the companies may benefit from economics of scale in that, for the most part, the computer system design and configuration will be the same for all the applications and, although the overall design is somewhat developmental, complete system configuration design for each application will not be required.

Each of the companies already has a plant process computer in place and operating. Proposals should address the hardware required for the SAS computer system as well as replacing the existing process computer and incorporating its current capability in the proposed new configurations. Thus, two sets of itemized pricing information are required of the Bidder. Bidder's proposal will include shipment f.o.b., installation, testing, operator training, hardware, and software for the entire system including related peripheral equipment.

It is expected that Bidder's will respond with a proposal delineated by his scope of supply appropriately modified to meet the special requirements of this Specification.

Each bid must conform to this Specification unless specific exceptions are listed in the proposal. The number of such exceptions should be minimized by the Bidder so far as possible. Exceptions deemed necessary by the Bidder shall be clearly itemized in a separate and distinct section of his proposal. If conflicts exist between the proposal and the material contained within this Specification, and said conflicts are not listed as "Exceptions" as prescribed above, the requirements set forth in this Specification shall govern. The Bidder may submit alternative or optional features for consideration by the Purchaser. The Appendices list the information to be included in the proposal, as desired by the various companies, in addition to that requested by this common Specification.

Each company intending to submit a proposal in accordance with this Specification shall inform the Purchasers in writing fourteen (14) days after issuance of inquiry. Each company indicating its intention to submit a proposal will be placed on an official list of Bidders and will receive such additional data and changes as may be released by Purchasers and will be invited to attend Bidders' conferences.

Should a Bidder find any discrepancies, or question the meaning or intent of any portion of this Specification, the Bidder may request clarification from Purchasers, in writing, at least twenty-one (21) days before bid submittal deadline. Purchasers will respond within ten (10) days after receipt of question. Answers to each Bidder's questions will be forwarded to all Bidders.

In the event of conflict between the common portion of this Specification and the respective company's Appendix, the respective company's Appendix shall govern.

1.2 Summary Description of Computer System

The computer system required is expected to be configured of sufficient computers to service the unit(s) at each plant at the desired level of availability. Bidder is requested to propose a computer configuration similar to that on attached diagram but may suggest alternate configurations which satisfy the Purchaser's redundancy/availability requirements. The Safety Assessment System (SAS) consists of all hardware shown on the block diagram above the dashed line marked "NUREG-0696". The Process Computer System is that hardware below this line. The SAS computer is designed not only to fulfill the requirements outlined in NUREG-0696, but also serve as a high reliability "front-end" for the plant process computers.

The attached block diagram does not detail all the specific peripherals required for support of the SAS and plant process computers. Such items as programmers console and magnetic tape units should be included by the Bidder as necessitated by this Specification.

This Specification is divided into three sections: 1) General Requirements, 2) Functional and Technical Requirements for SAS, and 3) Functional and Technical Requirements for Plant Process Computer. The Bidder is requested to submit a proposal covering both the SAS and Plant Process computer systems. It is the Purchaser's intention, however, that if the Purchaser requests it, (see appropriate Appendix), that the SAS may function by itself without the presence of the Plant Process Computer.

1.3 Expandability

Because Purchaser's requirements for processing and/or computational capability may increase in the future, it is requested that proposals reflect Bidder's ability to expand his proposed systems in these areas.

1.4 Definitions

As used in this Specification, and the appendices, the following words shall be understood to have the following respective meanings:

PWR	Pressurized water reactor
NSSS	Nuclear steam supply system.
PURCHASER(S)	The listed companies above jointly submitting this Specification.
CONTRACT(S)	The contract(s) for the computer system, peripheral equipment and related services as described in this Specification.
BIDDER	The company who decides to furnish Purchaser(s) with proposals for the contract.
CONTRACTOR	That Bidder whose bid is accepted by the Purchaser(s) individually and who will be awarded contract(s).
SPECIFICATION	This document, all appendices and attachments thereto and all documents incorporated herein by reference.
SUBCONTRACTOR	A person, firm, or corporation other than the Supplier and its employees who supply labor and/or materials for a portion of the Contract.
PLANT SITE OR SITE	The location and extent of the referenced nuclear power plants as described in the respective appendices.
WORK	Includes such efforts as design, developmental, manufacturing installation, programming, training, and documentation services performed under the contract.

UNIT	A single NSSS and electric generator system together with all its associated auxiliary systems, capable of electrical power generation.
TSC	Technical Support Center, location of safety assessment system displays and other computer output devices of this computer system.
SAS	Safety Assessment System as described herein.
EOF	The near-site facility used for evaluations and controlling emergency situations that may effect the public.
PPCS	Plant Process Computer System
Appendix or Appendices	The appendices hereto which provide plant specific information or requirements. The plant specific requirements presented in the Appendices modify and supersede those presented in the common requirements portion of this Specification.
NDL	Nuclear Data Link

2.0 GENERAL

2.1 Scope of Work - Contractor

Contractor shall furnish and deliver f.o.b. to each Purchaser's nuclear power Plant Site a digital computer system configured to service the respective unit, or, in the case of two-unit plants, to service both units simultaneously, complete with all appurtenances, programs and other software to meet operational requirements as hereinafter specified.

2.1.1 Hardware

The digital computer system shall include, but not necessarily be limited to the following:

2.1.1.1 Digital computer including input, output, memory, arithmetic, and control units.

2.1.1.2 Analog to digital conversion equipment, as appropriate.

2.1.1.3 Power distribution facilities and power regulating equipment including those needed for contact closure inputs as appropriate.

2.1.1.4 Special heating, cooling and/or ventilating equipment required for individual cabinet environmental control.

2.1.1.5 Input and output termination cabinets.

2.1.1.6 Analog input selection, filtering, isolation, amplifying and signal modification equipment.

2.1.1.7 Output printers, typewriters, display devices, recorders, consoles, desks, etc.

2.1.1.8 All interconnecting cables between above listed items of equipment.

2.1.1.9 Cables are to be prefabricated plug-connected.

2.1.2 Services

Contractor-provided technical assistance will be required for the following:

2.1.2.1 Engineering assistance required to properly interface with existing sensors.

2.1.2.2 Complete programming including flow charting, coding, translating, program entry and debugging will be done by Contractor.

2.1.2.3 Drawings, instruction books and complete printed and machine readable source programs on magnetic tape.

2.1.2.4 One year's supply of all specified log sheets, chart paper, and non-standard forms if required.

2.1.2.5 If preprinted log sheets are specified, any of the Purchasers shall have the right to reorder additional log sheets from Contractor as may be required.

2.1.2.6 Training of Purchaser's engineering, programming, maintenance, and operating personnel.

2.1.2.7 Recommendations for spare parts.

2.1.2.8 Special test equipment.

2.1.2.9 All supervision required to install and place in service the complete system.

2.1.2.10 Acceptance and Reliability testing in accordance with the appropriate sections of this specification.

Contractor shall furnish the services of a competent installation and field service engineer and programmer who shall be available as required for proper installation of the computer system, loading of the required programs and placing them in operation, and as required by Purchasers, through the initial startup of the equipment, debugging, and checkout until the system is operating with the generating units on line.

The cost of all installation and field services performed by Contractor's field service personnel shall be included in Contractor's proposal as a firm price.

In the event the Contractor's personnel, while on the job site, are unable to perform any service due to nonavailability of a unit or equipment of a Purchaser, all such lost time shall be billed to the respective Purchaser on a per diem basis should the Purchaser request that Contractor's service personnel remain on the job site while Purchaser's equipment is returned to service.

All expenses for such services that are determined by a Purchaser to be the result of the Contractor's error, omission, failure to meet contract conditions, etc., shall be borne completely by Contractor.

Contractor shall provide sufficient drawings and manuals of equipment provided to enable Purchasers to effect repair, replacement, or regular maintenance on the equipment. Availability of spare parts, if necessary, should be addressed in the proposal.

Contractor should provide sufficient instruction, including software for programmed checkout of the computer system and components.

2.2 Scope of Work - Purchaser(s)

Purchasers will provide engineering assistance as required to define the project and coordinate the new computer system interfaces with other plant equipment.

Purchasers will supply two independent, highly reliable, power sources for the system.

Purchasers will specify formats of computer output data displays. A list of signals to be monitored and their related sensors will be provided in the respective Appendices.

Purchasers will provide all sensors and/or transducers which are required. Transducer output will be as shown in an input-output list. Contractor shall furnish additional transducing equipment, voltage dividers, filters, RTD bridges, etc., required to make these signals compatible with the data system input equipment.

Purchasers will provide labor and materials to install the computer system hardware.

Purchasers will provide engineering assistance required to define the program and coordinate the data system with other plant equipment. This assistance may be furnished in part by the Purchaser's engineers and/or in part by their consulting engineers.

2.3 Schedules

Current plans call for the following schedules:	(See Appendices)
Issuance of bid request	11/17/80
Notice of intent to submit proposal	12/1/80
Receipt of proposal	2/1/81
Contract award	5/1/81
Delivery of SAS hardware	5/1/82
SAS installation complete	9/1/82
SAS beginning of acceptance run	12/1/82
SAS final acceptance of hardware and software	1/1/83
SAS availability - Verification Run Completion: (no later than)	1/1/84

Within 30 days after receipt of notification of award of contract for furnishing the computer system, Contractor shall submit to Purchaser for review a detailed schedule of the sequence and time required for the engineering, design drawing, drawing submission and review, manufacture and shipment of the software and equipment to be furnished by the Contractor.

Purchasers shall review the schedules and it shall be used thereafter throughout the length of the project.

It shall be the Contractor's responsibility to maintain the progress of his work in accordance with the approved schedule.

The project schedule will be revised and updated as the work progresses. Projected slippages in project schedule exceeding 30 days shall immediately be brought to the Purchaser's attention. It shall be the responsibility of the Contractor to advise the Purchasers of the actual progress of the work prior to each revision.

2.4 Changes

Changes in the scope of the work may be proposed from time to time by one or more of the Purchaser(s). Contractor will promptly inform the respective Purchaser of the economic and schedular effects of such changes.

2.5 Contractor's Guarantee and System Availability

Contractor shall adhere to the requirements on guarantee and availability as specified in Articles II-3.8 and II-3.12.

The availability run will commence no later than six (6) months after installation is complete provided the Contractor's system is ready.

Date of acceptance shall be the date the availability run ends. The Contractor's warranty will be in effect for one year after the start of the availability run or until the completion of the availability run, whichever occurs last.

2.6 Subcontracted Work

Contractor shall not sublet any part of the Work without first obtaining Purchaer's written approval. Contractor shall be responsible for providing inspectors to witness and verify in-progress fabrication, examination and tests performed by his Subcontractors and to ensure that the Work is progressing on schedule and in accordance with Specifications.

2.7 Specified Products and Substitutions

Mention of materials or components by name or as products of certain manufacturers in the Specification is made to ensure that the proper quality and/or type is provided. Substitutions of other manufacturers' appurtenances may be offered in the proposal. Specific information about such substitutions must be included in the proposal. Where substitutions are not itemized in the proposal, it will be understood that the Contractor is including the items referenced. No substitutions will be considered after award. Products of other manufacturers will be acceptable if Contractor furnished proof that the proposed substitute products are equal to or better than the specified products in quality, performance, design, and suitability for the intended use.

2.8 Origin of Subsystems

The Contractor will advise as to any subsystems manufactured outside the U.S.A. which he intends to incorporate into the equipment. If foreign manufactured subsystems are included in the work without prior notification, the Contractor shall, upon notice in writing, replace the subsystems at his own expense including installation, and shall be liable to the Purchaser for any damage to the Purchaser's plant and any losses due to any delay caused the Purchaser by such replacement.

2.9 Cost Breakdown

Purchaser is required by his respective regulatory agencies to determine segregated costs of "units of property". Contractor will furnish Purchaser a schedule of such "units of property" and Contractor will agree to furnish a breakdown of material costs accordingly prior to final payment on the Contract.

2.10 Additional Terms and Conditions

The following terms and condition will be subject to separate negotiations between individual Purchasers and Bidder consistent with requirements presented in the respective Plant specific Appendices.

Contract Administration

Project Control

Delays

Cancellation

Insurance

Injuries and Damages

Patent Indemnity

Title and Risk of Loss

Payment Schedules

3.0 ADDITIONAL REQUIREMENTS

3.1 Standards

As a general requirement the equipment shall be designed, manufactured, documented, and installed in accordance with applicable IEEE, ANSI, and ANS standards. Bidder is requested to provide a breakdown of the standards he plans to use for various aspects of his work. Particular attentions to the requirements of ANS 4.5 will be required for the Safety Assessment Systems.

Parts of the current plant equipment have been built to IEEE Class 1E standards. This equipment must not be degraded as a result of the new installation.

3.2 Quality Assurance

Contractor shall submit for review and acceptance, his quality control manual with his proposal.

As a minimum the Contractor's Quality Assurance Program shall meet the requirements of Nuclear Regulatory Commission Regulation 10CFR50, Appendix B.

The Contractor shall be responsible for assuring that his subcontractors and vendor's Quality Control program meets the specified requirements imposed on the Contractor by the Purchaser.

Bidder should describe his Quality Assurance procedures which will apply to his programming work.

3.3 Factory Testing

Factory testing shall be accomplished in accordance with the requirements as specified herein.

3.3.1 Contractor shall develop a recommended Purchasers' inspection point program. This program shall include the manufacturing, inspection and test operations which the Contractor believes may be of interest to the Purchaser in demonstrating product quality, whether performed in his or his subcontractor's facilities. The recommended Purchasers' inspection point program shall be submitted within six (6) weeks after award of contract.

3.3.2 Six (6) weeks after award of contract the following applicable procedures shall be submitted for review and acceptance.

3.3.2.1 Test procedures; tests shall be conducted in accordance with applicable industry standards such as ANSI, IEEE and NEMA.

3.3.2.2 Cleaning and painting procedures.

3.3.3 Quality control documentation shall be submitted to Purchasers' for review and acceptance. All documentation shall be clear, legible and of suitable quality for microfilming and/or storage for the life of the plant.

3.3.4 The Purchasers' and/or his designated representative shall have full access to the Contractor and Subcontractor's facilities for reviewing conformance to the approved quality control program, records, and for witnessing of inspections and tests. Purchasers shall be notified at least three (3) working days prior to the start of the tests and inspection points as specified by the Purchaser.

3.3.5 Contractor shall perform a complete functional test of the systems at the factory before shipment using the final program and simulated inputs. The Purchasers shall have the opportunity to participate in the simulation and to introduce random upsets as he desires.

3.3.6 Prior to shipment, all components of the system shall have experienced power-on operation for at least 30 days unless otherwise agreed. At least 5 days shall be as an assembled system which shall be coincident with the factory system tests. An assembled system includes all computer main frame, I/O, termination and related cabinets, all peripherals, such as typewriters, printers, operator's console, displays, recorders, etc., and the associated plug connected interconnecting cables.

3.3.7 Factory tests shall be scheduled far enough in advance of shipping date to permit debugging hardware and/or software problems which may occur during the tests. Tests shall cover all functions to be performed by the computer system.

3.3.8 Purchasers shall be notified of the test dates in writing at least 30 days prior to the tests and shall be given a list of the proposed test procedures with that notification. Tests shall be subject to approval by Purchaser.

3.3.9 All system subassemblies or subassemblies identical in design and construction shall have undergone tests under ambient temperature conditions as specified herein without malfunction or degradation of performance. Subassemblies shall be construed to be amplifiers, analog-to-digital converter, power supplies, arithmetic units, memory units, etc. In addition, the complete system shall be proven to have successfully undergone complete functional system tests over the ambient temperature, voltage and frequency limit specified herein. Contractor shall furnish certified proof that these tests have been performed on this or a similar system.

3.3.10 Upon satisfactory completion of the system test, the equipment shall be considered completed and no hardware shall be changed, replaced, substituted or otherwise altered except upon written agreement with the Purchasers. Under no circumstance may the system hardware be used to supply parts for test or substitution in other systems in the Contractor's facilities. The system may be used by Contractor's and/or Purchasers' programmers to continue the program debugging and entry during the period between completion of the test and shipment to the field.

3.3.11 The Purchasers reserves the right to refuse shipment of the computer until a satisfactory system test has been demonstrated. If Purchasers elect to have the computer shipped at the scheduled shipping date, the Contractor is responsible to bear all costs of field debugging and such debugging must be performed at the earliest possible date.

3.4 Equipment Packaging, Shipping, Storage

The equipment shall be arranged and packaged as follows:

3.4.1 The output devices and operator's control panel shall be mounted, and located in the Control Room, and the cables will enter the equipment as specified in this Specification or in the plant specific Appendices.

3.4.2 The balance of the computer equipment shall be furnished in the system's cabinets located as specified. If it is necessary to ship the cabinets in two or more sections, provisions shall be made for bolting the sections together in the field and making interconnections by means of plug connected prefabricated cables, all furnished by Contractor.

3.4.3 Cabinets shall be drip-proof, sheet steel enclosures fabricated of smooth rolled steel and so designed as to form rigid, self-supporting units of neat appearance for floor mounting. Cabinets shall have formed hinged doors with latches, handles and locks and shall be furnished complete with antivibration mounts if required, and any necessary special hardware required for floor mounting. Cabinets shall be designed to facilitate maintenance and replacement of equipment mounted therein. Cabinets shall have an air "Filter Clogged" alarm.

3.4.4 The outsides of cabinets shall be given a prime coat and a smooth durable finished coat of Contractor's standard colors (unless specified otherwise). Consoles located in the control room shall be a color agreed upon by the Purchasers.

3.4.5 The Contractor shall adequately prepare all of the equipment to withstand any possible damage or loss due to rough handling or exposure to weather during transit or extended outdoor storage. Where required by the nature of the equipment, the Contractor shall furnish and install necessary covers to protect the equipment from rain, hail, wind, dust, etc. Openings shall be adequately sealed and protected during shipment to prevent corrosion, entrance of foreign matter and possible damage from rough handling during transit and storage. Screwed outlets shall be provided with plugs. All exposed machined surfaces shall be protected with a suitable antirust compound approved prior to shipment.

3.4.6 Equipment shall be prepared for shipment with provisions for lifting and/or skidding. All lifting points shall be clearly marked.

3.4.7 All equipment and separately shipped items shall be clearly identified with a securely fastened, weatherproof tag, labeled with Purchasers' Name, Purchase Order No., Equipment No. (if applicable), Manufacturer's Shop Order Number and Service. All shipping containers, packing lists, bills of material, correspondence, etc., shall be identified with the same above information. All boxes, shipping containers, crates, etc., shall have a packing list firmly attached to the exterior and a duplicate packing slip packed within.

3.4.8 The system terminal, typewriter or printers will be refurbished as new before shipment to the Purchasers' plant.

3.5 Contractor's Drawings

After notification of award, Contractor shall submit the following to the Purchasers for review:

3.5.1 Outline dimensions drawings of all equipment, including terminal block arrangements.

3.5.2 Functional block and intersystem cabling diagrams of the system.

3.5.3 Detailed input and output listing and termination details.

3.5.4 Schematic, wiring and connection diagram. Wiring diagrams showing terminal connections for Purchasers' incoming and outgoing cables shall be prepared and submitted in accordance with the layouts presented in plant specific Appendices.

3.5.5 Complete Bills of Material for Contractor's equipment, including all special appurtenances furnished with the equipment.

3.5.6 Drawings and data shall be submitted in the form of 35 mm microfilm or aperture cards. The preparation, submittal and intermediate handling of aperture cards shall be in strict accordance with the requirements set forth herein.

3.5.7 After final review of wiring diagram, and schematics of electrical equipment furnished under this Specification, Contractor shall furnish reverse reading negatives as specified in the Appendices.

3.5.8 Engineering details shall begin immediately after award of contract and be completed in accordance with a schedule established by the Purchasers and the dates in the proposal, regardless of shipping date.

3.5.9 The Purchaser shall be advised promptly if changes in equipment requested by them affect the price or delivery. The original price shall cover a reasonable number of changes in drawings incident to rearrangement of equipment to meet the Purchasers' requirements.

3.5.10 Design information must be submitted on certified drawings or in letters during the design period of the project. The fact that such design information may later be included in the instruction books does not relieve Contractor from compliance with this requirement.

3.5.11 After notification of award, Contractor shall submit for review, drawings and data as specified herein.

3.5.12 Single line and key diagrams of power distribution circuitry shall be submitted.

3.5.13 All submittals of drawings and data shall include identifying information as set forth in the following:

3.5.13.1 Contractor's order or job number.

3.5.13.2 Purchasers' instrument or identification number.

3.5.14 Schematic, wiring and connection diagrams. Wiring diagrams of all cabinets and consoles included in the contract shall be prepared and submitted. Input terminal assignments shall be acceptable to or determined by Purchaser.

3.5.15 After final review by the Purchasers' of the wiring diagrams Contractor shall supply reproducible tracings and 35 mm microfilm aperture cards of the final corrected drawings. These shall be sent to the Purchasers at least four weeks prior to the scheduled equipment shipping date.

3.5.16 Contractor's review drawings shall apply specifically to this contract and separate drawings are required for each unit.

3.5.17 If general "standardized" drawings are submitted for review which include devices which Contractor does not intend to supply on this contract, said drawings shall specify which devices are not to be supplied. Drawing transmittals not meeting this requirement will be immediately returned to the Contractor for correction without comment.

3.5.18 All drawings submitted to Purchasers are subject to the Purchasers' review and/or comments. Comments or notes marked on the Contractor's drawings shall not constitute approval for cost extras, nor shall such comments relieve the Contractor of his responsibility of complying fully with this Specification and all applicable codes. Expected cost extras or conflicts between drawing comments and the Specification shall be immediately reported to the Purchaser.

3.5.19 A drawing being transmitted for review for the first time shall so state on the transmittal sheet or letter accompanying the drawing. No drawing shall be strictly for Purchasers' record or information until it is acceptable.

3.5.20 It shall be the responsibility of the Contractor to determine the date when review drawings must be returned so that the shipping schedule specified in the contract can be maintained. The Purchasers shall be advised of said return date at the time review drawings are transmitted. In any case, said return date shall occur no less than a period of three weeks after the date when drawings are transmitted.

3.5.21 It shall also be the responsibility of the Contractor to obtain Purchasers' acceptance without comments on those drawings covering an item at least two weeks before that item is to be shipped. Contractor shall be liable for the costs of those field changes resulting from failure to adhere to this requirement.

3.5.22 Purchaser's Final Drawings

Contractor shall furnish one final mylar reproducible of every drawing.

3.6 Contractor's Instruction Books, Manuals, Listings

Contractor shall supply the following information to the Purchasers.

3.6.1 Instruction Books: Twelve (12) copies of detailed and comprehensive instruction books shall be transmitted six months prior to shipment of hardware. These books will cover maintenance operations, installation, lubrication, illustrated parts breakdown, and programming of the system. The instruction books shall be applicable to the specified equipment furnished, including all Vendor items. The books shall include detailed schematic drawings, assembly drawings, interconnection lists and illustrated photographs for (but not limited to) the following:

3.6.1.1 System function diagram.

3.6.1.2 Equipment identification by function name.

3.6.1.3 Connection and wiring diagrams for all equipment.

3.6.1.4 Schematic diagrams of all computer system components necessary for understanding operation and maintenance.

3.6.1.5 Design data sheets, performance curves and final performance capability for all equipment.

3.6.1.6 Description of the I/O equipment.

3.6.1.7 Detailed input and output listings of terminations.

3.6.1.8 Instruction books shall be thoroughly edited before submittal, to exclude and/or to cross out text, data, illustrations, etc., that do not apply to the specific equipment purchased.

3.6.2 Four copies of Programming Manuals and sixteen (16) copies of Operating Manuals shall be furnished for each Purchasers' trainees.

3.6.3 Programming Documentation Books

Four copies shipped at the same time as the computer. These shall be complete with up-to-date flowcharts and program descriptions and an outline of how the programs operate.

The programming documentation shall include the following:

3.6.3.1 Dictionary

A dictionary of variable names of all variables used in the system shall be included. The following information shall be included in this dictionary:

- Variable name.
- Verbal description.
- Storage length.
- Which programs and subroutines used the variable.

3.6.3.2 Statement Numbers

Wherever possible, flow charts are to include the statement numbers of the source program so that a cross-reference can easily be made.

3.6.3.3 Comments

Comments indicating the function of any particular portion of coding are to be included on all programs. These comments shall occur no less frequently than one comment for every three lines of source code.

3.6.3.4 One magnetic tape of all programs.

3.6.3.5 One source magnetic tape.

3.6.3.6 Programs furnished shall be complete and contain all necessary "patches". Manual "patching" of the initial system programs shall not be allowed.

3.6.3.7 Any software licensing agreements required by the Contractor shall allow the installation of Contractor-supplied software on another manufacturer's system for the sole use of the Purchaser.

3.6.4 Detailed descriptions of all proposed system functions, including operator action and system response for all functions. This shall be sent to the Purchaser for review prior to freezing system design.

3.6.5 Two (2) master copies for each Purchaser of:

3.6.5.1 Source and object listings of all programs.

3.6.5.2 Flowcharts and descriptions of all programs.

3.6.5.3 Main memory, drum and/or disc memory maps.

3.6.5.4 All constants, tables, variable specifications, etc., needed to modify system functions.

3.6.5.5 Source and binary magnetic tapes for all programs.

3.6.6 Contractor shall also supply the following information to the Purchaser.

3.6.6.1 Part lists shall be complete in every respect. Parts shall be identified by the original manufacturer's part number as well as by Contractor's identification number.

3.6.6.2 Contractor shall submit three copies to each Purchaser of instruction books for review before final copies are prepared.

3.6.7 Contractor shall be held responsible for supplying additional information, or replacing information or entire instruction books, operating manuals, programming manuals, flow charts or program descriptions, if field inspection of equipment indicates omissions or inaccuracies in the books.

3.7 Purchasers' Training

Contractor's formal training program shall meet the requirements as set forth below. Training shall be available prior to installation at Purchaser's discretion.

3.7.1 Contractor's formal training program shall be arranged for the following numbers of Purchasers' personnel:

3.7.1.1 Up to two (2) programmers for each Purchaser: Programmers training shall be sufficiently comprehensive so that Purchasers' personnel can make any programming changes. Courses shall cover basic and/or advanced programming concepts.

3.7.1.2 Up to two (2) maintenance technicians for each Purchaser: Maintenance training shall include, as a minimum, the main frame and all peripheral equipment.

3.7.1.3 Up to fifteen (15) plant operators and ten (10) plant supervisors at the Purchasers' plant (operating instructions).

3.7.2 The Contractor shall provide a comprehensive formal training course for Purchasers' personnel at the Contractor's plant in data system theory, programming, operating and maintenance. In addition, the Contractor shall provide formal training at the power station in maintenance and operating procedures.

3.7.3 Contractor shall pay all training expenses, except trainees' salaries, travel and living expenses.

3.7.4 Contractor shall make arrangements to include Purchaser's programmers/analysts in all phases of programming.

3.7.5 The Bidder shall furnish with his proposal a tentative training schedule, and cost to obtain videotapes of training classes.

3.8 Spare Parts

Bidder shall submit with each copy of his proposal an inclusive spare parts quotation. The inclusive spare parts quotation shall:

3.8.1 Be inclusive for and applicable to all equipment components, auxiliaries, accessories and materials being furnished under the Contract.

3.8.2 Includes for each recommended spare part the unit price, quantity, description, catalog number, part number, drawing reference(s), etc., to completely identify the item and the equipment component for which it is recommended.

3.8.3 Parts shall be identified by the original manufacturer's name and part number as well as the Contractor's identification number.

3.8.4 Include the f.o.b. point(s), shipping point(s), payment terms and shipping estimate, and equipment lead time.

3.8.5 All requirements regarding quality control and documentation that apply to the original parts of the specified equipment shall apply equally to the spare parts of the specified equipment.

Bidder shall include with the system recommended spare parts required on-site by Purchasers to maintain the availability requirements as specified in Parts II and III of the computer system for a period of two years. Contractor shall include only those spare parts which are economically reasonable to store at a plant installation. Contractor will be able to make use of Purchasers' spare parts during the installation, start-up and availability run of the computer system. The Contractor shall replace any spare parts used.

The Contractor will provide complete manufacturing details including generic part numbers, full scale art work, and such other information as may be needed by the Purchaser to permit him to duplicate any part in the system. Furthermore, the Contractor shall license the Purchaser to manufacture such equipment for his own use and guarantee that spare parts will be available until December 1989 or until 5 years after the product is withdrawn from the market, whichever occurs last.

3.9 Installation

The equipment shall be arranged and packaged as specified herein and in the plant specific Appendices. In general the Technical Support Center is located within 500 feet of the control room, whereas the Emergency Operations Facility is 5 to 10 miles from the plant boundary.

3.9.1 The output devices and operator's control panels will be located in the control room. Cables will enter from below.

3.9.2 The engineer's/programmer's console, programmer's typewriter, and card reader will be located in the computer room. Cables will enter from below.

3.9.3 The balance of the computer equipment shall be furnished in the system's cabinets. All incoming field cables and all prefabricated cables shall enter the cabinets from below. Each cabinet temperature shall be monitored and alarmed by the computer system.

3.9.4 The precise location of where each item of equipment will be installed will be as described in the plant specific Appendices, subject to any spatial limitations imposed by the Contractor's equipment. Bidders should provide, in their bids, an approximation of the space and weight handling requirements of their hardware. Bidders may propose alternate equipment layout.

3.9.5 Purchasers' present system will remain in operation until such time as the new system is completely installed, checked out, debugged and tested.

3.9.6 Bidders will provide for Purchasers' review a description of how his computer power distribution and protection circuitry will be designed along with a description of the types of fuses and circuit breakers employed.

3.9.7 While the Purchasers' power sources will normally be regulated, the computer systems shall be suitable for operation on 120 (±10%) volt, 60 (±1%) Hertz power. Contractor shall provide any and all necessary filtering regulating and isolating equipment required to ensure operation of the computer systems from this power source.

3.9.8 The voltage of the input power supply for operation of the computer system shall be provided by Purchaser as specified in the plant specific Appendices.

3.9.9 A power distribution system shall be provided for all computer system equipment and peripherals. Circuit breakers shall have an interrupting rating of 10,000 amps (rms) symmetrical.

3.9.10 Purchaser will provide multiple feeds 120 volt, 60 Hz, single-phase, two-wire, grounded power.

3.10 Diagnostic Software

The following discussion is provided to describe the diagnostics which the Purchaser believes to be required to support the SAS and Plant Process Computer Systems. If the Contractor's standard offerings are significantly different from the diagnostics described herein, the Contractor will offer these as an option. To maintain the system efficiently, a comprehensive diagnostic software package will be required. Diagnostics will be supplied to test each peripheral as well as the central processing units. As with all other software, the Contractor will supply complete documentation, including logic level flow charts, source decks and tapes, and loadable object modules.

These diagnostics may be categorized as either corrective maintenance diagnostics or confidence diagnostics.

3.10.1 Corrective Maintenance Diagnostics

Four levels of corrective maintenance diagnostics are required. Corrective maintenance diagnostics will be supplied for each identifiable device in the system.

Level 1

A stand-alone version of diagnostics for every device. These diagnostics should be able to operate and provide maintenance personnel with useful information when a minimum amount of hardware is operational.

Level 2

A stand-alone version of diagnostics for every device. These diagnostics will assume that most hardware is operating properly. They will be as comprehensive as possible. A complete system exerciser also will be provided.

Level 3

Diagnostics shall operate off line under monitor control and shall be self-configuring. These diagnostics assume that the central processing unit and most other hardware are operational. Diagnostics of this category will be supplied to test all peripheral devices. This set of diagnostics is the most comprehensive and the most flexible diagnostics supplied with the system.

Level 4

Diagnostics shall operate on line in the real-time environment under monitor control and shall be self-configuring. These diagnostics can be used to test any peripheral. Precautions must be taken to maintain the correct and proper operation of the system while these diagnostics are in execution.

3.10.2 Confidence Diagnostics

Diagnostic routines designed to assure that the system is operating properly will be supplied. Routines will be supplied to test each device off line. These routines should require little or no operator attention. They should be comprehensive. The output from these diagnostics should be minimal.

In addition, an idle-time diagnostic will be provided to test the system continually. This diagnostic will be as comprehensive as possible and will require no operator intervention. This diagnostic will operate at the lowest priority in the system and the time that it is in execution will be counted

as idle time. It will at no time inhibit or slow the system's response to external events.

3.11 Additional Proposal Data

In addition to the completed Proposal Form, Bidder shall furnish the following with each copy of his bid:

3.11.1 Detailed specifications covering construction and materials used in the equipment.

3.11.2 Drawings showing general arrangement and principal dimensions.

3.11.3 A complete description of the shielding required on input leads and a written guarantee that the system will meet specified accurancy and reliability with that degree of shielding.

3.11.4 Description of factory tests to be performed.

3.11.5 List of similar systems which Bidder has on order and/or in service.

3.11.6 Programming and storage breakdown by functions. Storage should be subdivided into core and drum or disk.

3.11.7 Data analysis for environmental tests should be submitted with the proposal. If Contractor is supplying a new model computer for which no environmental tests have been run, an environmental reliability test shall be performed at the specified ambient temperature range (59 to 104 F) and relative humidity (10-95% non-condensing) at the Contractor's facility. The Vendor shall propose his plan for accomplishing this task.

3.11.8 Description of diagnosis and maintenance programs supplied with the machine.

3.11.9 Description of contract maintenance service available from Bidder.

3.11.10 Proposed schedule for design, manufacturing, shipment, installation and checkout of hardware and software.

3.11.11 If a compiler is specified, a description of all features of the compiler which differ from standard ANSI Standard X3.9-1978 for FORTRAN.

3.11.12 Bidder shall furnish documented results of response times of low priority inputs at the time of the worst case duty cycle. If this is not available, simulation studies should indicate the effects of the worst case duty cycle on scanning alarming and display update timing.

3.11.13 Bidder shall furnish documentation stating the ultimate capacity of the processors that he is proposing to fulfill the requirements of Parts II and III. This ultimate capacity should be defined, as a minimum, in terms of: number of inputs, maximum point conversion rate, memory size, and additional output devices.

PART II: SAFETY ASSESSMENT SYSTEM

1.0 GENERAL

1.1 Part II of this Specification describes the functional and technical requirements for the Safety Assessment System (SAS). The general requirements outlined in Part I apply also to the SAS.

1.2 The purpose of the SAS is to:

1. Provide the safety-related operator displays required by NUREG-0696 in the control room, TSC, and EOF.

2. Serve as the data acquisition system for not only the SAS but also the plant process computer system.

2.0 FUNCTIONAL REQUIREMENTS DESCRIPTION

2.1 Safety Assessment System Functions

The following description of the SAS is provided for the purpose of illustrating the system hardware requirements. A software specification and development of the software itself for the SAS will be obtained by the Purchasers under a separate contract. This software, including the necessary algorithms, human factors considerations and common, high level language programming, will then be made available to the Contractor for his incorporation into his software such that the functional requirements described in this specification are met. Software development and implementation, however, for the SAS operating system, data-acquisition and parameter passing to the plant process computer shall be the responsibility of the Bidder.

2.2 Safety Assessment System

The Safety Assessment System is a computer based system that will aid the operator in determining safety system status (pre- and post-accident) and accident identification. The major features of a typical Safety Assessment System are described below.

- Displays of at least nine key parameters - six of these may be normalized bar graphs, three may be digital (but not alpha-numeric) displays.

- Accident Identification Displays (AID's) graphically inform the operator of the relative probability that each of the three major accidents may be occurring (loss of coolant accident, steam generator tube rupture, and secondary system rupture).

- A Safety System Ready Monitor that displays the status of safety systems during normal operation if a loss of redundancy occurs or if a loss of function occurs.

- An accident mitigation monitor assesses proper safety systems functioning during an accident and will alert the operator if loss of a vital function occurs during the course of an accident.

- Graphs of at least 13 critical parameters for the last 30 minutes.

- Historical data (30 minutes storage) for each of the parameters (maximum of 40 parameters, minimum of 20), required for the AID's.

- Displays of current values and trends of the parameters required for the AID's.

The most essential features are presented to the operator via two color CRT displays. The first (the "normal" or pre-accident display mode) incorporates the first three features above and would be the usual display. The AID's are yellow vertical bar graphs whose heights represents the relative probability of occurrence for three accidents. The AID's occupy most of the right hand side of the display. The normalized parameters are displayed on bar graphs on the left of the screen. The digital parameters are displayed below the AID's alert messages. Messages from the safety systems ready monitor are displayed above the AID's.

2.2.1 Key Parameter Display

Six of the parameters that are essential to early diagnosis of an accident are displayed on the left side of the CRT "normal mode" display. Parameter values are normalized for for all normal operating modes operation so that their sizes are approximately equal. The displays are bar graphs (either horizontal or vertical). While a normalized parameter is within established limits, its bar is green in color. If a parameter is not within these limits, the bar is red.

Three additional parameters comprise the remainder of the normal parameter display. These may use digital or analog inputs and display. The lower right hand portion of the CRT (page one and two) is used for this portion of the display, the information is coded green when it is within normal limits and red when it exceeds these limits.

The six normalized parameters are:

- Pressurizer Pressure

- Pressurizer Level

- Reactor Coolant System Tavg

- Steam Generator Pressure

- Steam Generator Level
- Steam Flow-Feed Flow (Mismatch)

The three parameters that may be displayed digitally are:

- Containment Pressure
- Containment Radiation
- Air Ejector Radiation

2.2.2 Accident Identification and Display System

Those parameters necessary to identify the four major accidents; loss of coolant, steam generator tube rupture, inadequate core cooling and secondary system rupture, are used by the AID's program. The magnitude of and rate of change of each of these parameters is evaluated for its importance as an identifier (symptom) of each accident. Values are assigned accordingly and put in a "register" for each accident. The register totals are representative of the relative probability of that accident being in progress. The register totals may be displayed as three vertical yellow bars whose height is proportional to its register's total value. The algorithm for assessing the relative accident probabilities will be developed by Purchasers and provided to Contractors for programming. This display is a part of the Normal Mode Display and the Accident Mode Display.

The system may display at the request of the operator, a page showing the parameters considered to be an identifier for the accident of interest, the current value of the parameter, the trend of the parameter (increasing, decreasing, or constant) the value currently assigned that parameter in that accident registry and the accident register total. There is a separate page for each accident. The system should be able to operate during a normal heatup and cooldown with the AID's indicating a high accident probability only if one exists.

The following parameters are used by AID's:

Parameter	Identifier For Loss of Coolant	Steam Generator Tube Rupture	Secondary System Rupture
Pressurizer Pressure	Yes	Yes	Yes
Pressurizer Level	Yes	Yes	Yes
RCS Temperature	No	No	Yes
Steam Generator Level	No	Yes	Yes
Steam Generator Pressure	No	No	Yes
Steam Generator Blowdown Rad	No	Yes	No
Containment Temperature	Yes	No	Yes
Containment Pressure	Yes	No	Yes
Containment Humidity	Yes	No	Yes
Containment Sump Level	Yes	No	Yes
Containment Radiation Level	Yes	No	No
Air Ejector Radiation	No	Yes	No
PORV Position	Yes	No	No
Code Safety Valve Position	Yes	No	No
Steamline Flowrate	No	Yes	Yes
Feedwater Flowrate	No	Yes	Yes

A list of signals used for these parameters is provided in the Plant specific appendices

2.2.3 Safety System Ready Monitor

This monitor is used to determine that essential safety systems are in the proper condition to fulfill their design safety functions if an initiation signal were received. The minimum requirement for a system status determination is a switch and valve lineup verification. A broader determination of operability can be obtained by including other inputs some of which may be manual such as tank levels, pressures, temperatures, chemistry, bus voltages, etc. The method of display is an alert message on the SAS CRT. The operator could, utilizing one of the plant process CRT's, call up the respective flow diagram, which would display to him which piece of equipment in that system is causing that system to be classified "unavailable". The Boolean logic to compute system determination will be performed in the PPCS CPU's. The results of this logic shall be passed to the SAS CPU's as a contact closure generated by the PPCS and monitored by the SAS Computer. Upon detection of contact status change the SAS computer will generate and display the appropriate message.

2.2.4 Accident Mitigation Monitor

This system checks certain system alignments and operation. The monitor may be activated by a safety injection signal. For the first 60 to 90 seconds following the activation signal, the monitor checks for the proper startup of safeguards equipment, including Phase A containment isolation. If an error is detected, a message such as

"Safety Injection Sequencing Error" is displayed. Through the use of a function push-button the operator may call a lower level display for additional detail.

After 60 to 90 seconds, the monitor checks the following systems for proper operation:

Function	Check Initiated By	Items Verified
Safety Injection	RCS Press < X	HP/LP SI Flows
Cold Leg	SI	Valve Position Indication
Hot Leg	Hot Leg Vlv Opened	Valve Position Indication
Accumulator Discharge	RCS Press < Y	Accum Press = RCS Press
Boron Injection	BAT to RWST Xfer	Valve Position/Tank Level
Termination/Restart	SI Reset	Displays "Do Not Terminate" message until termination criteria satisfied
Recirculation	RWST Lo-Lo Level	Valve Positions-RHR/SI Flows
Containment Spray	Cont Press > P	CS Flow (Press), NaOH Level*
Containment Isol	Cont Press > P	Valve Positions
Auxiliary Feedwater	S/G Level < Z	AFW Flows

NOTES: X = HP/LP SI pump shutoff heads
Y = Accumulator discharge pressure
Z = Lo-Lo level setpoint
P = Phase B containment pressure setpoint

The flows listed in the items verified should be based on pump curves for existing system pressures, if possible.

If a loss of function is detected, the message "XX System Malfunction, see page YY" is displayed. The monitor will continue the system checks until terminated by the operator. SI reset will not terminate the checks.

*Displays "Do Not Reset" message if containment pressure and radiation are high.

2.2.5 Critical Parameter Trending and Display

The critical parameters used in developing the AID's display must also be capable of display on local and remote SAS CRTs terminals.

2.2.5.1 Parameter Graphs

Four (or five) graphs of certain plant parameters should be displayed on the left side of the CRT (accident mitigations mode). The graphs should show the trends for the past one-half hour. This method of display facilitates prediction of plant conditions in the near future, thus aiding the decision making process. Actual values, rather than normalized

values, should be displayed. In the case where the parameters may vary widely, automatic scale changes or range selection is necessary. The parameters graphed would include:

Steam Generator Pressure (4)
Reactor Coolant Temperature
Reactor Coolant Pressure
Primary System Inventory (Pressurizer Level and/or Reactor Vessel Level)
Steam Generator Level (4)
Reactor Coolant Sub-cooling
Containment Pressure

2.2.5.2 Historical Data Base

Historical data of the parameters used in the AID's should be maintained for a minimum of one-half hour, with first-in/first-out storage. The amount of main memory allocated for this storage should be a minimum of 36K bytes. The entire data base may be printed upon operator demand, via the links to the plant process computer system. While system is transferring the historical data base the data base shall be "frozen". Any new data shall be entered into a new data base.

2.2.5.3 AID's Parameter Displays

Three separate display formats are available upon command of the operator. Each accident in the AID's should have its own display. Each of the identifying parameters for a particular accident is listed, along with its current value, its trend (increasing, decreasing, or constant should be indicated by up arrows, down arrows, or no arrows, respectively) and the current AID's value assigned it. The AID's total is also displayed.

The second display may incorporate the second, fourth and fifth features of Article 2.2 into the accident mode display. The AID's occupy the same location as in the normal mode display. The graphs of the fifth feature of Article 2.2 occupy the left half of the display and alert messages appear above the AID's in the event of a safety system malfunction (see examples in the respective Appendix).

2.3 Nuclear Data Link

2.3.1 In the event that a Purchaser does not immediately procure the PPCS, the SAS computer system shall have the capability of supporting the Nuclear Data Link.

2.3.2 The function of NDL is to supply the NRC Headquarters with vital plant parameter values.

2.4 Push-Button Function Panel

A push-button function panel shall be provided so that the operator may obtain any desired SAS display merely by depressing a single push-button. Since the displays described in section 2.2 are not interactive, only these push-buttons are required.

2.5 Additional Safety Assessment System Functions

2.5.1 It shall be the function of the SAS to scan all inputs from the field multiplexors, check for limits and place point values in a common database. From this database the routines described in section 2.2 above will obtain the necessary point values. These algorithms will also generate output values which will be added to the database. This database will then be transmitted to the plant process computer(s) and the backup SAS computer.

2.5.2 The SAS computers shall have the capability of receiving a synchronous ASCII data from other computer systems via an EIA-RS232 link. Data transmitted to the SAS shall also be incorporated into the SAS database.

2.5.3 On-Line Sensor Calibration

When specified in the Appendices, the system shall be arranged to permit calibration of sensors which are removed from scan.

- The program shall provide for entry of calibration data for all analog inputs. Calibration data printed out at the programmer's console shall include point identification, actual value (manual input), measured value (in both millivolts and engineering units) and related information. The measured values which are printed out should be an average of at least 12 readings by the computer.

- The program shall provide the entry of calibration data, fitting the data to an equation of up to the fourth order, and entering the data into memory.

3.0 TECHNICAL REQUIREMENTS

3.1 General

3.1.1 The SAS computer system shall have the capability to implement those functions described in section 2.0 above.

3.1.2 The SAS computer system shall be designed to provide the required 99.9% availability as defined in section 3.8.

3.1.3 Insofar as possible, all system components shall be of solid state, standardized, modular, plug-in construction so that any module may easily be removed from the system and replaced without breaking or making solder-type connections. It shall be possible to interchange subassemblies of like function without making wiring changes. The number of types and sizes of modules shall be kept to a minimum in order to reduce the extent and cost of spare parts required.

3.1.4 Equipment shall be provided with operation indicating lights, test panel and/or other features required to facilitate testing. A means of checking the operation of the entire system shall be included and self-checking diagnostic routines shall be included in the program. As a minimum, such routines shall not only notify the operator of a malfunction, but also indicate the area in which the difficulty is located.

3.1.5 The system shall include extensive self-checking to detect malfunction of the input equipment, memory parity errors, lost or spurious interrupts, program hang-ups, and other feasible checks that indicate erroneous operation. When such checks show a problem from which the system can recover without intervention by plant personnel, a system error shall be alarmed and logged and operation shall resume. If the check reveals a nonrecoverable error, an orderly shutdown shall be performed, leaving in computer memory whenever possible such information as will enable plant personnel to readily locate and correct the problem.

Power failure shall always be considered a recoverable system error. On loss of power, an orderly shutdown shall be performed by the system, storing all volatile information and registers in nonvolatile memory. On restoration of power, the system shall safely resume operation, printing a message which includes the time of the power failure. The only manual intervention that shall be required for restart after power outage is the setting of the computer's clock to the correct time-of-day and date through the operator's panel.

3.1.6 For that equipment will be installed in an air conditioned room. It shall be suitable for operation in an ambient temperature range of 59°F to 104°F for those periods when the air conditioning may be off. It shall also be suitable for operation through a relative humidity range of 10% to 95% throughout this temperature range.

3.1.7 Slide wires and contact-making devices such as relays and stepping switches shall not be used unless approved by the Purchasers (except that Mercury-wetted relays are permitted for input and output circuits).

3.1.8 Overall accuracy of the data system shall be such that the digital output representation of an analog input signal shall be within ±0.10% of full scale range of the signal as

measured at the analog input terminals. Equipment design shall insure this level of accuracy over a six-month period without the necessity of manual recalibration.

3.1.9 Resolution of the analog to digital converter shall be a minimum of one (1) part in 4,000. (Full scale for this accuracy shall not be more than 50 mv.)

3.1.10 Suitable techniques shall be provided to automatically and periodically:

3.1.10.1 Correct the digitized signal for zero offset.

3.1.10.2 Multiplex and digitize signals for standard reference voltages and limit check the difference between the digitized values and the standard values.

3.1.11 Total SAS processor cycle time utilized shall not exceed 60% accomplishing the functions specified in Article 2.2 above.

3.2 Programming

The system shall provide programming features which will facilitate design, programming, debugging, installation, and maintenance of the complete system. Programming features shall include, but not be limited to, the following:

3.2.1 A program structure specifically designed for on-line process applications.

3.2.2 It shall be possible for Purchaser's trained personnel to make on-line and/or off-line program changes; however, the main program stored in bulk storage shall be protected against unintentional destruction by power failure, tampering with operator's console, computer generated command, computer malfunction or erroneous data or program entry.

3.2.3 If required, hardware double precision arithmetic will be used to maintain accuracy of the system.

3.2.4 Programming aids shall be provided to permit on-line printing of any section of memory for minor program changes and debugging.

3.2.5 The system shall perform any linearization, scale factoring, zero suppression, ranging, span or zero adjustments, etc., as may be required to present all variables in their usual units of measurements regardless of their input values. The system shall automatically check for open thermocouples each scan cycle and must give suitable indication to the operator

the first scan cycle after the thermocouple opens. Batteries are not acceptable for this function.

3.2.6 The system shall be provided with as a minimum a foreground/ background software system which allows on-line compilation in ANSI X3.9-1078 FORTRAN and library maintenance. The computer contains all the necessary bulk and core memory required for the on-line compiler and the computer shall also have the means for protecting core memory against unintentional changes.

3.2.7 Contractor is responsible for furnishing complete programs stored in the computer, debugged, tested, and in operation. Contractor shall perform all work required for programming including flow charting, coding, translating, program entry and debugging. Each Purchaser may elect, at his option, to assign two (2) men to work with the Contractor during the programming phase of the work. A programming schedule shall be established and maintained by the Contractor to insure that programs are available to meet system guarantees.

3.3 Memory Protection

The computer system as a whole and each computer shall include the hardware facilities to protect selected areas of the working memory and program portions of the memory.

3.3.1 The system shall be provided with automatic failover. The fail over to the backup computer(s) shall be made upon actuation of the dead man timer or by a fatal computer error. Upon failure of the master computer, all input devices and all output devices shall be automatically transferred to the backup computer.

3.3.2 The computer system shall also have the ability to be manually switched to the backup computer. Failover shall not occur until backup computer has been updated with all current information from the master computer.

3.3.3 Each main power supply which will cause system shutdown shall be provided with a redundant power supply by the Purchaser. In the event a power supply transfers to the redundant supply, an alarm message shall be generated and printed.

3.3.4 Memory elements are preferred to be semiconductor memory. The memory system shall be capable of detecting and correcting all single bit and detecting all double bit memory errors.

3.3.5 The operating system and in general the central processor shall be capable of supporting more than 64K bytes of main memory.

3.4 Operation

3.4.1 The basic concept of this system is that each SAS computer would look at all data inputs (from both field multiplexors and external computer systems). Each SAS processor would keep its database constantly "up to date".

3.4.2 In addition each SAS processor would independently drive a display generator for the SAS CRT. Upon failure of the designated primary SAS processor, the system would automatically, (with manual override) switch over to the backup SAS processor and its own display generator.

3.4.3 Actuation of a function pushbutton would not only update the display generator of the primary SAS processor, but also that of the backup processor. With this mode of normal operation, the displays and database of the backup SAS processor would be "up to date".

3.4.4 When a computer is being returned to service, the on-line computer shall store data directly onto the auxiliary memory in order to update its file. This shall be done on a low priority basis so as not to interfere with the normal operation of the computer.

3.4.5 All high speed data transmission between computers shall include data security checks such as parity checks and check sum. If an error is detected, transmission shall be halted immediately at the point of detection and the transmission shall be repeated. If the error is repeated, the data link shall be declared out-of-service.

3.4.5.1 All updating of the backup auxiliary memory shall have parity checking or check sum checks.

3.4.5.2 All data channels shall have inherent hardware isolation so the failure will not affect the backup computer system.

3.4.5.3 Both computers shall have the ability to run diagnostics when they are on-line to verify that the computers, auxiliary memory, peripheral controllers and software are functioning properly.

3.4.6 The decision for switch over to spare computers shall be completely automatic and shall require no manual intervention.

3.5 System Functions

Consistent with Article 2.0, the computer system shall perform the following functions:

3.5.1 Scanning

The system shall continually and automatically scan the analog and digital inputs from the plant as described below:

3.5.1.1 Analog Inputs

The system shall select and measure analog inputs on a random basis under program control. Input programming and selection equipment shall be arranged to provide various scanning rates for various inputs. Unless otherwise stated, the basic scan classes shall be as follows:

1/10 second interval
1 second interval
5 second interval

The system shall be arranged to permit changing of the scan class of any input under SAS program control.

3.5.1.2 Digital Pulse Type Inputs

The System shall provide for pulse type inputs. Purchaser's input device will provide electrically independent contacts to the system. Scan classes shall be as follows:

1/60 second interval (fast scan)
1 second interval (slow scan)

3.5.1.3 Contact Closure Inputs

The system shall provide for contact closure inputs as described in the Appendices.

The system shall provide continuous scanning of all status and alarm contact inputs. All the inputs shall be scanned at least once each second.

The SAS processors and field multiplexors shall provide for scanning of up to 200 digital (contact) inputs for sequence of events recording. These inputs shall be scanned at high speed to discriminate between contact operations which occur a minimum of 5 milliseconds apart. When a sequence of events is initiated the contact sequence shall be passed to the PPCS for printout and display.

3.5.1.4 The Contractor shall assist the Purchaser in assigning scan classes to the various inputs to provide the most meaningful data.

3.5.1.5 All points, upon completion of conversion to engineering units and limit checking, shall be placed in a data base which is to be used by the SAS programs and passing to the plant process computer system.

3.5.2 Data Transfer to Plant Process Computer

3.5.2.1 All composed and scanned analog and digital point values generated by the SAS system shall be able to be transferred to either Plant Process Computer via the dedicated communications link, which should be hardware independent.

3.5.2.2 Point values shall be transmitted on a scan cycle basis. The SAS shall have the capability to transmit a total database update on demand by the Plant Process Computer System (PPCS).

3.5.2.3 Communication between the SA and PPCS should conform to CCITT X.25 protocall standards, or other protocall that is "generic" and not machine dependent. The Bidder is requested in his proposal, to describe his method of accomplishing this communications link.

3.5.2.4 The hardware connection between data terminal equipment and data communications equipment should conform to EIA-RS232C requirements.

3.5.3 Nuclear Data Link (NDL)

The Nuclear Data Link hardware will be supplied by the Nuclear Regulatory Commission. It will be the responsibility of the SAS (or PPCS, see Article 2.4.1) computer to supply the NDL with correct format of digitized data as described below:

1. Digitizing rate and resolution.

   Each NDL parameter specified shall be sampled at a sampling rate of once per minute with a minimum of 12 bit resolution. Each reading shall be time-tagged with an absolute time tag having a resolution of 5 seconds.

2. Format and transmission requirements to the NRC terminal.

   Data shall be transmitted to the NRC terminal in American Society for Communication Interchange (ASCII) code serial form, meeting signal and level requirements of Electronic Industry Association (EIA) Standard RS-232-C. The data stream will meet detailed header and text format requirements specified by NRC specifications to be provided at a future date. The data stream must be continuous on one minute intervals.

3.6 Field Multiplexors and Input Signal Racks

3.6.1 It is the Purchasers intent to purchase, as a minimum, the multiplexor arrangement shown on the attached block diagram. The Bidder shall allow for expansion of his input multiplexor system and should state in his proposal the maximum number of analog and digital inputs possible given the scanning requirements of section 3.5.1 above.

3.6.2 The multiplexor - A/D conversion subsystem should be "state-of-the-art" design and should incorporate such features found in "smart" remote multiplexors, e.g., reporting by exception, limit checking.

3.6.3 The field multiplexor units and input-output (IO) cabinets shall be designed to meet the seismic qualification requirements of section 3.7.1.

3.6.4 The field multiplexors and input termination cabinets shall be designed to operate not only in a controlled environment but under these field conditions: 40-120°F and 10-100% relative humidity (non-condensing).

3.6.5 Description of Existing Input Sources

The input signals can enter the computer system directly as in the case of some thermocouple and resistant temperature detectors or as processed signals from equipment racks. The equipment racks are powered by up to five independent power supplies in each unit. Monitors are provided on each of the power supplies as computer inputs. In the event of an individual power supply failure, the computer system shall tag as invalid those signals derived using the afflicted power supply. The input signal sources are as follows:

3.6.5.1 Thermocouples

Direct: Types E, J, and J, 0 to 50 millivolts and 0 to 5 volts, d.c.

3.6.5.2 Resistant Temperature Detectors

Industry standard such as 100, 200 ohm platinum, and 10 ohm copper grounded and ungrounded.

3.6.5.3 System Analog Signals (typical)

0 to 1 volt

0 to 5 volts

1 to 5 volts

0 to 10 volts

0 to 50 millivolts

4 to 20 milliamps

10 to 50 milliamps

3.6.5.4 System Digital Signals

Contact closures

3.6.5.5 Point identifications shall consist of six characters, two alpha and four numerics. Alpha-numeric descriptions for inputs shall consist of at least 32 characters. The alpha-numeric characters (A through Z, 0 through 9) shall be combined in sequence as described by the Purchaser. As far as practicable, the identifications should be similar to the identifications on existing plant process computers.

3.6.6 Input System

3.6.6.1 The input system includes the transducers, cables, cable pans, conduits, and input terminal cabinets, as hereinafter specified.

3.6.6.2 The Input-Output tabulation in the plant specific Appendices lists all of the inputs. All of the signal transducers will be furnished by the Purchasers. The output signals from the Purchasers' transducers are given in the tabulation and Contractor shall provide any necessary additional signal conditioning equipment to make the signals compatible with the computer input.

3.6.6.3 Alarm and Sequence of Events (Alarm) Contacts

- Treatment of Contacts

  -- Contractor shall provide an isolating optical coupler for each alarm contact. The isolating optical coupler shall provide an isolated input to the computer input circuits. Input circuits shall be designed to withstand spurious signals of 2500 volts peak, 1.5 megaHertz, 150 ohms impedance. The repetition rate of the transient may be 60 times per second for two seconds, and inadvertent grounding or application of 250 VAC or ± 250VDC.

  -- Purchasers' visual annunciator will provide 125 volt DC output power supplies to power the Contractor's isolating devices.

-- Contractor shall employ methods to prevent contact bounce from causing multiple entries and transient noise from causing a false input. The methods utilized shall not cause errors in resolution between contact exchanges.

-- The contact input circuits shall be designed to present low enough impedance to allow reliable ground fault detection at the excitation voltage specified.

-- Failure of the computer shall not cause malfunction of a visual annunciator. Disconnection or malfunction of a visual annunciator, except for the power supplies for the isolating devices, shall not interfere with the operation of the computer.

- If the Contractor utilizes ungrounded 125 volt DC for the contact input operating voltage, the ground detection system shall continuously monitor both sides of all the contact inputs. When a ground occurs, an alarm message shall be printed on the alarm printer.

- If the Contractor utilizes a grounded 125 volt DC for the contact input operating voltage, an alarm message shall be printed on the alarm printer indicating a ground has occurred and the indicating type fuse has been blown.

3.6.7 Connecting Cables, Conduits, and Cable Pans

3.6.7.1 Purchasers will furnish and install all cables between his process transducers and field contacts and Contractor's terminal cabinets.

3.6.7.2 Prefabricated cable for connections between the various system cabinets, printers and control panels shall be furnished by Contractor.

3.6.7.3 Cable connections shall be arranged to permit easy identification of the individual circuits and to facilitate testing and maintenance. Cables between data system cabinets, printers, and control panels shall be plug connected on both ends.

3.6.8 Shielding and Filtering

The ambient electrical noise level of the power station may be extremely high. The Contractor shall be responsible for eliminating the noise presented by the power station to his

system by providing suitable shielding of sensors and input leads and by providing adequate filters and/or other devices which suit the design of his equipment, so that system accuracy and reliability is maintained at guaranteed levels. System design shall eliminate the necessity for shielding or isolation of digital input leads.

3.6.8.1 Contractor shall furnish all power and signal cables between the computer cabinets, the peripheral devices and the terminal cabinets. The cables shall be prefabricated cables equipped with plug connectors and receptacles on each end. Each signal cable shall consist of at least #18 AWG tinned copper wire with 600 volt insulation with an overall jacket meeting the requirements of IEEE-383-1974. Shielding shall be provided if required by the equipment.

3.6.8.2 For bid purposes, cables between system cabinets and the control room and Technical Support Center, peripheral devices shall be assumed to be 150 feet in length or as specified in Appendices. Price will be adjusted on basis of Unit Prices for any increase or decrease in actual installed average length. Incoming and outgoing cables will enter the computer and terminal cabinets from the bottom.

3.6.8.3 Each cable shall be identified at both ends with Contractor's cable numbers, utilizing a "hot-stamp" marking on heat shrink tubing which is then slipped over the cable or conductor.

3.6.8.4 One section of data system equipment cabinets shall be designated input terminal cabinets. The cabinets shall be partitioned off or otherwise segregated from the data system equipment components so that they may be left open without exposing the electronic components to dust and dirt normally encountered during the installation period.

3.6.8.5 The Bidder is encouraged to utilize fiber-optic links to the extent practical. The Bidder should state in his proposal if fiber-optic links are available.

3.6.9 RTD Power Supplies

Contractor shall furnish one separate power supply per each twenty-five (25) RTD inputs and the necessary number of RTD bridges.

3.6.10 Signal Conditioning and A/D Conversions

3.6.10.1 Analog signal inputs shall be isolated by mercury-wetted relays or agreed upon equal. Relays shall be energized by solid state circuitry.

3.6.10.2 Thermocouple measuring circuits shall be linearized over their entire usable range. Contractor shall provide cold junction reference boxes as appropriate. Boxes shall be remotely mounted or mounted in the input terminal cabinet as necessary and provided with cold junction temperature sensing RTD's for automatic compensation within the computer. The cold reference junction temperature shall be accurate to ±2°F maximum. Thermocouples will be grounded and ungrounded types and Contractor's equipment shall be arranged to handle them in any combination thereof.

3.6.10.3 The input impedance of all analog amplifiers shall be high enough such that they may be connected to a voltage source with a source impedance up to 50,000 ohms and still maintain system accuracy.

3.6.10.4 The input equipment shall provide necessary high and low level internal signal isolation as well as suitable shielding, filtering and noise rejection circuitry to provide digital readout stability consistent with system accuracy requirements.

3.6.10.5 The analog signal from the selection and conditioning circuits shall be converted to a digital signal by an all-electronic, all solid state, static, null balance type of circuit, or agreed upon equal.

3.6.10.6 Voltages up to 250 V DC or peak-to-peak AC erroneously placed on analog signal leads shall not cause system damage. The analog input circuits shall be capable of withstanding, without component damage or misoperation, a transient voltage of 2500 volts peak, 1.5 megaHertz, 150 ohm source in 10 microseconds from the start of the transient. The repetition rate of the transient may be 60 times per second for two seconds.

3.6.10.7 Analog amplifier shall be capable of scanning an over range signal of five times normal operating range without affecting accuracy of the next scanned input.

3.6.10.8 System minimum noise rejection capability from field terminals to readout shall be:

- Common Mode

  -- 120 db from DC to 60 Hz and 1000 ohm unbalance.

- Normal Mode

  -- 60 db at 60 Hz

3.6.10.9 A/D Calibration

Periodically, each analog-to-digital (A/D) converter and each amplifier will be checked for accuracy. If programmable gain amplifiers are used, each range will be checked.

Batteries will not be used as a voltage or current source. The standard supplies used for this purpose will be immune to fluctuations of ±16 percent in the input voltage. The operator will be alerted to problems with the standard supplies.

Warning messages will also be issued if any amplifier or converter drifts more than 0.25 percent of full scale. The identity of offending elements will be incorporated in the daily maintenance log.

3.6.11 Input Terminal Cabinets

-- Input terminal cabinets shall be separate from the computer cabinets. Input cabinets shall contain nothing other than terminal strips, raceway, and one duplex convenience outlet. Contractor shall provide all prefabricated plug connected cables between the input terminal cabinets and the computer cabinets. For bid purposes, it shall be assumed that input terminal and computer cabinets are not adjacent and that the cables between the terminal cabinets and the computer cabinets are 150 feet in length, or as specified in the Appendix. Each type of cabinet shall be designed to accept these cables from the bottom. Terminal strips shall conform to the requirements specified in the Appendices.

3.7 Seismic Capability

3.7.1 It is recognized by the Purchasers that seismically qualified computer systems are not generally available. However, the Purchasers are required by the Nuclear Regulatory Commission to develop, design and install a SAS that will survive an operating basis earthquake (OBE). The OBE is defined as: "that earthquake which could reasonably be expected to affect the plant site during the operating life of the plant; it is that earthquake which produces the vibratory ground motion

for which those features of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional".

3.7.2 Section 6.1.4 of IEEE-344-1975 states that "Any tests listed in the following sections may be used for qualification of equipment to the OBE". Therefore, the test procedures used to qualify the input termination cabinets, multiplexors, A/D converters, SAS computers, and the color graphic CRTs and their controllers shall be in accordance with section 6.0 of IEEE-344-1975.

3.7.3 Proof of seismic qualification will be the ability of the system to survive one OBE (as shown on figure II-1), without loss of function.

3.7.4 Only those components which are required to fulfill the functional requirements in section 2.0 are required to be seismically qualified. Other components such as programmer's console, line printer(s), magnetic tape unit(s) and/or floppy disk drives not required to support those functions in section 2.0 but used for example to load the system, run diagnostics, etc. are exempt from the requirements of this section. The Bidder, however, shall show that these devices are sufficiently isolated such that their potential failure would not result in a loss of function in the SAS.

3.7.5 The Bidder should make every effort to comply with the requirements of this section, and shall state his capability to meet these requirements in his proposal. Partial or total non-compliance with this section will not necessarily dismiss a Bidder from further consideration, provided good sound engineering arguments are presented for the degree of non-compliance stated.

3.8 Availability

3.8.1 The SAS computer system (including field multiplexors, display generators, and CRTs) shall be designed such that it has a 99.9% availability. For purposes of the specification the SAS is considered to be unavailable when a failure to display or generate any one of the parameters required for the displays described in section 2.2 above occurs, (except if the failure is caused by sensor failure).

3.8.2 2200-Hour Availability Test

The Purchasers and the Contractor will conduct a 2200-Hour System Availability Test of the system delivered under this contract. The Contractor and the Purchasers will be permitted to have representatives present at any time during the test.

The System Availability shall be 99.9 percent for the 2200-hour test. Availability is as defined in paragraph 3.8.1 above.

3.8.2.1 Definitions

Accumulated outage time (AOT) - the total amount of time after start of test when any part of the system or SAS functions are unavailable. Any repairs requiring call-out for factory service shall not be counted as outage time until the serviceman has arrived or twelve hours have elapsed, whichever occurs first.

Accumulated outage time (AOT) shall be calculated as follows:

$$AOT = T_R + T_L$$

Where: T_R = time to correct fault

T_L = time which exceeds twelve hours for offsite serviceman to arrive after notified

All times will be recorded to the nearest minute.

In the event that the accumulated outage time (AOT) exceeds 2.2 hours, the start time shall be shifted to delete some of the previous outages until the cumulated outages during the 2200-hour test no longer exceed 2.2 hours. The shifted start date shall be mutually agreed upon between the Purchasers and the Contractor. No time shift will be permitted until at least 25 percent (550 hours) of the test has been completed. The computer system must be operating at 100 percent at the end of the test.

Any time the computer is down due to a noncomputer-related event, such as power failure, this time will not be counted as outage time. A noncomputer-related failure does not include any equipment supplied under this contract. This time shall be accrued as operating time unless the outage is present for more than eight hours, at which time the test shall be stopped. When the cause of the outage has been corrected, the test will be re-started and the elapsed time the system was down will not be counted.

Preventive Maintenance

Prescheduled outages to perform mandatory maintenance as required by the Vendor's instruction manuals shall not be counted as outage time. Preventive maintenance shall be limited to such functions as cleaning and lubrication. The Seller shall take all necessary precautions to prevent important computer functions from being unavailable during this

period and shall provide a description of preventive maintenance required, including duration, complexity, and any loss of functions prior to start of the test. Any preventive maintenance in excess of two hours that causes loss of system functions shall be counted toward outage time.

3.8.3 Availability Test Log

A log of system outages, including preventive maintenance repairs, service calls, and parts used to repair, shall be kept jointly between the Owner and the Seller.

3.8.4 Specific rules for Availability Test

a. The duration of any outage shall be determined as the time period that a functional deficiency is first recognized and the time the deficiency has been corrected and verified by the Owner.

b. The test shall not begin until all plant inputs are connected, Owner training has been completed, recommended spare parts are in stock and all preventive maintenance has been completed.

c. If an intermittent failure occurs, those which occur and then disappear, three times, the problem shall be isolated and repaired. The system will be considered unavailable while corrective maintenance is being done. System unavailable time will be calculated per Section 3.8.2.1.

d. No minimum time shall be charged against any occurrence.

e. Alteration to software shall not be permitted unless required to correct an error.

f. Alterations to the hardware shall not be permitted unless required to correct a failure, or in the opinion of Contractor, such changes will improve system reliability.

g. The Purchaser will be permitted to test the performance of the system as specified during the Availability Test.

h. Any redesign or modifications to the system that are a result of the Availability Test will be made to and documented for all systems supplied by this Specification.

i. The Contractor will provide a service representative on call 24 hours/day, 7 days/week for the duration of the availability test.

j. The Purchaser will replace any spare parts removed from the Contractor's spare parts supply that were used during the Availability Test.

k. Outages resulting from causes external to the computer system, caused by negligence, misoperation, or misuse or abuse of the computer system by employees or agents or the customer, or due to exceeding environmental and input specifications applicable to the equipment, shall not be charged as down time, but shall be accrued as system operating time.

l. All down time shall be mutually agreed upon by the Purchaser and Contractor.

m. A new test shall be started if major modifications are required to either hardware or software in order to conform to specified functional requirements. A maximum of one test repeat may be run for this reason at Purchaser's discretion. Any additional test repeats will be by mutual agreement.

3.9 Peripheral Requirements

3.9.1 Color Graphic CRTs

3.9.1.1 The Contractor shall supply software subroutines to drive the SAS display generators given values from core resident data base(s) (supplied by Others).

3.9.1.2 The color graphic CRTs supplied by the Contractor shall be specified by the Purchasers prior to Contract finalization. The Bidder should provide in his system design and proposal the capability and cost for a color graphic CRT similar to Ramtek or Aydin 5216.

3.9.2 A programmer's console shall be provided with the system and shall be a hardcopy device.

3.9.3 A magnetic tape unit or floppy disc drive should be provided by the Contractor to allow loading of system software, diagnostics, etc. If a magnetic tape unit is provided it shall be dual density (800/1600 BPI) NRZ/PE format, 9 track, with a minimum read/write speed of 75 ips.

3.9.4 Display Generators

If multiported, multiplexed display generators are used, it is permissible to configure them with two of the four control room CRTs on a single display generator. It is understood that different displays may be on each CRT.

3.9.5 Peripheral Switches

All equipment involved in executing real-time plant monitoring functions employs programmable peripheral switches to direct data to/from the appropriate CPU. The switches depicted in the attached block diagram Figure 1, are functional in intent. If the Seller's standard equipment is designed with multiple ports, the peripheral switches may not be required.

3.9.6 Logical Device Substitution

Devices will be referred to by logical names. The programmer will have the ability to change the definition of these logical names either permanently or temporarily.

3.9.7 Operator's Function Panel

A separate push-button function panel shall be supplied. This panel shall be capable of remote mounting from the SAS CRT. Sufficient engraved function push-buttons shall be provided, one for each function described in Section 2.2. An equal number of blank push-buttons shall be provided as spares.

Attachment 2
Technical Support Center
June 8, 1981

The general arrangement and design details are shown on drawings 21489-362 and 181-101 with elevations and sections as shown on drawings 181-102 and 181-103. As shown, the overall TSC is comprised of three distinct but adjoining structures occupying approximately 7000 square feet. The south wall is located on the north column line of the control room but one elevation lower, satisfying the "in close proximity to the control room" requirement.

The main or central facility is a one-story reinforced concrete structure placed upon the existing condensate demineralizer building (CDB), itself a concrete structure. The central area is shielded, and houses the required personnel in operating and supporting areas to accomplish the primary TSC activity. Fixed walls define those spaces which need not afford flexibility in their arrangement. These spaces are the records center, a conference room, kitchen, toilet rooms, entrance corridors and vestibules, and instrumentation, radiation monitoring and communication equipment areas. Full height, demountable partitions enclose a computer and the NRC office. The display area and perimeter office space achieve definition by the use of removable partitions to provide maximum flexibility for alternative functions and activities. The total area is raised approximately one (1) foot on an access floor to provide display cabling and utility line space in any portion of the TSC.

The second distinct structure is a non-shielded one-story space north of the TSC built over the remainder of the CDB. It houses the HVAC equipment and provides storage and/or office space. The charcoal filters in the mechanical equipment room are shielded from the main TSC area.

The third distinct structure is located south of the TSC and CDB area and houses a diesel generator, uninterruptible power source and battery rooms. It is a non-shielded, one-story unit built upon grade and is separated from the main TSC by an interceding corridor which serves as an indoor link between the Turbine Building and the TSC's southern entrance. Under-floor access using removable floor panels is provided in this corridor area to accommodate the extension of all display cabling from the existing relay room to the access floor beneath the TSC.

The electrical power system is designed to provide normal power and emergency power to the TSC computer and electrical equipment and is described in Attachment 1. The physical arrangement of most of these components is shown on Drawings 21489-362 and 181-101.

The room temperature of the TSC will be controlled by a variable air volume (VAV) system. During the warmer periods of the year, cooling will be provided by mechanical or outside air cooling delivered by the air handling and conditioning unit. When heating becomes necessary, a steam heating coil in the system will heat the supply air.

The charcoal system of the VAV will be put into operation manually when required. In this case, the system will be operating in a full recirculation mode.

In the battery room, UPS room, and diesel room, separate fans and heaters shall be controlled thermostatically.

This facility is nearly complete and will be available for occupancy as the TSC in the near future.