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August 9, 1985

Docket Nos. 50-277
50-278

Mr. Hugh L. Thompson, Jr., Director
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Peach Bottom Atomic Power Station Units 2 & 3
Safety Parameter Display System
(NUREG-0737, Supplement 1)

REFERENCE: NRC Staff's Audit of the Peach Bottom
Safety Parameter Display System, dated
April 3, 1985, H. L. Thompson, NRC,
to E. G. Bauer, Jr., PECo

Dear. Mr. Thompson:

As a result of NRC findings identified in the referenced audit report and discussions during a June 14, 1985 meeting with the staff in Bethesda, MD, we have re-evaluated the Safety Parameter Display System (SPDS) at Peach Bottom. This letter proposes a new computer-based SPDS design for the Peach Bottom Atomic Power Station. Further the letter provides our justification for the current analog design as an interim SPDS.

The original SPDS design, which was reviewed in the referenced audit, consisted of analog indicators and recorders on two control panels and was consistent with our interpretation of NUREG-0737, Supplement 1. The key NRC requirements, as stated in that document, were:

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- SPDS should provide a concise display of critical plant variables to control room operators.

- The SPDS should continuously display information from which the plant safety status can be readily and reliably assessed by control room personnel who are responsible for the avoidance of degraded and damaged core events.

- SPDS need not meet requirements of the single-failure criteria and it need not be qualified to meet Class IE requirements.

- The SPDS should provide information to plant operators about: reactivity control, reactor core cooling and heat removal from the primary system, reactor coolant system integrity, radioactivity control, and containment conditions. The specific parameters to be displayed shall be determined by the licensee.

- The operator should be trained to respond to plant events with or without the SPDS.

- Human factors principles should be applied to the SPDS displays.

- The design of the SPDS should be integrated with the emergency procedures, Regulatory Guide 1.97, and a control room design review.

Philadelphia Electric Company concluded in 1979 that the expeditious development of symptomatic emergency operating procedures would significantly enhance emergency response capability and was one of the most important lessons learned from the TMI accident. This conclusion was based on both the recommendation of a PECo initiated study shortly after the TMI accident and those presented by the NRC in NUREG-0578.

In March 1983, Philadelphia Electric Company became one of the first utilities to implement NRC approved emergency operating procedures. The procedures were based on Revision 2 of the BWR Emergency Procedure Guidelines (EPG). Other emergency response enhancements, such as SPDS and Control Room Design Review, were designed with the intent of complementing the use of emergency operating procedures in the actual control room setting. For example, the emergency operating procedure entry conditions (parameters indicative of plant safety status) were used as the bases for the SPDS parameters.

A discussion of the NRC's findings identified in the April 3, 1985, audit report follows:

1. <u>NRC Finding</u>:

The variables selected for the Peach Bottom SPDS require the addition of a more direct indication of neutron flux, such as APRMs and SRMs, and radioactivity release rates.

<u>Response</u>:

The SPDS parameters selected for the proposed design were identified in a safety analysis submitted on September 28, 1983 (J. W. Gallagher, PECo, to D. G. Eisenhut, NRC) and later modified in a submittal dated July 17, 1984 (S. L. Daltroff, PECo, to G. W. Rivenbark, NRC). The basis for SPDS parameter selection was the entry conditions for the plant-unique emergency operating procedures. Neutron flux indication (i.e., the APRM's) is a part of the SPDS. Additionally, the current Source Range Monitor (SRM) indication will be designated as part of the SPDS as requested.

Radioactivity release rates were not proposed as an SPDS parameter since they did not represent an entry condition for the generic EPG, Revision 2, or the plant-unique emergency operating procedures. Entry conditions were adopted as the parameter selection criteria for the SPDS in order to establish consistency with the operators' use of the emergency operating procedures in response to plant transients. Further, Supplement 1 of NUREG-0737 states that the SPDS is used "in determining the safety status of the plant and in assessing whether abnormal conditions warrant corrective action by operators to avoid a degraded core." It also states that the SPDS is to be used "by control room personnel who are responsible for the avoidance of degraded and damaged core events." These two statements led us to the conclusion that the SPDS function of indicating the status of radioactivity control is related to the reactor core. However, Revision 3 of the EPG's has since been issued. The entry condition for the radioactivity control guideline in Revision 3 is offsite radioactivity release rate greater than the alert level. Consequently, we will incorporate the current offgas and vent stack radiation indication into the SPDS. Additionally, the current drywell high-range radiation indication will be designated as part of the SPDS since this parameter is used in the Emergency Plan to aid in the classification of an event as an alert, site emergency, or general emergency. Since the existing analog SPDS will be replaced with a computer-based SPDS, relocation of these parameters is not planned. However, human engineering enhancements will be implemented to incorporate these additional parameters into the analog SPDS concept.

2. NRC Finding:

The proposed SPDS design does not include an effective means to validate data.

Response:

Supplement 1 of NUREG-0737 requires the SPDS to display information from which the plant safety status can be reliably assessed. The guidance in NUREG-0835 and standard review plan Section 18.2 suggests the use of validation to meet the reliability requirement. We have chosen to meet the reliability requirement by using on-site power sources and periodically testing the instruments. For most variables, the instrument loops are treated as safety-related circuits. All sensors except one in Unit 3 are environmentally and seismically qualified. The remaining sensor is being replaced with a qualified sensor during the current Unit 3 refueling outage as a result of a Regulatory Guide 1.97 requirement.

From the discussions held at the June 14, 1985 meeting, it is our understanding that the use of instruments which meet Regulatory Guide 1.97 design and qualification requirements is an acceptable means of meeting the reliability requirements of NUREG-0737, Supplement 1. Since the SPDS instruments are the same ones being used to satisfy the Regulatory Guide 1.97 requirements, the analog SPDS conforms to the NRC position on reliability and, hence, validation.

3. NRC Finding:

The proposed SPDS design does not incorporate human factors engineering principles so as not to mislead operators during accidents.

Response:

Our original commitment was to integrate the human factors program for the SPDS into the Control Room Design Review (CRDR). The CRDR is currently underway and enhancements will be proposed in a Summary Report to be submitted by February 1986. The CRDR will address the specific human factors concerns identified in section 3 of the Technical Evaluation Report prepared by SAIC and transmitted to us in the referenced letter. Since the existing analog SPDS will be replaced with a computer-based SPDS, these human factors concerns will be addressed from the viewpoint of an indicating instrument. A task analysis of the SPDS function and major hardware changes to resolve the human factors concerns related to the SPDS function will be deferred. The new computer-based SPDS will receive its own human factors evaluation as required by supplement 1 of NUREG-0737.

4. NRC Finding:

The licensee has not provided the staff with information on the adequacy of isolation within the SPDS design.

Response:

The requested information was described in a July 17, 1984 submittal (S. L. Daltroff, PECo, to George W. Rivenbark, NRC). It is repeated below with the inclusion of information on the variables proposed for incorporation into the SPDS by our response to finding 1.

The circuits for the following parameters selected for the analog SPDS are treated as safety-related circuits from the sensors up to and including the SPDS indicators:

a) Suppression pool level
b) Suppression pool temperature
c) Drywell pressure
d) Reactor water level
e) Reactor pressure
f) Group I isolation valve position
g) Drywell high-range radiation

No isolation devices are used in these circuits to separate the SPDS from the sensors.

The circuits for drywell temperature, offgas stack radiation, and vent stack radiation are treated as non-safety-related circuits from the sensor up to and including the SPDS indicators. No isolation devices are used in these circuits.

The sensors for neutron flux indication are safety-related and the recorder is non-safety-related. Isolation is provided by a voltage divider circuit and fuses in accordance with the original plant design.

All electrical separation is in accordance with the criteria described in Section 7.1.6 of the Peach Bottom Updated Final Safety Analysis Report.

The remainder of this letter discusses the use of the presently installed analog SPDS and the plans to install a computer-based SPDS. The audit report identified the SPDS user as the shift supervisor at the operator's desk and expressed concern about his ability to read the SPDS instruments. This conclusion apparently resulted from a misunderstanding during the audit regarding who uses the Peach Bottom SPDS. The SPDS may be used by all members of the control room staff responding to a transient: shift supervisor, control operator, assistant control operator, and shift technical advisor. Normally, the control operator is the primary user of the SPDS. Attachment 1 is provided to supply additional information regarding the operator's response to a transient using the emergency procedure, control room instruments, and existing SPDS.

The Peach Bottom SPDS, as originally proposed, has been implemented on Unit 2 and will be operational on Unit 3 prior to the startup following the refueling outage scheduled for the Summer of 1985. As described above in the responses to the four

NRC findings, the system would comply with the NRC criteria except for the conciseness of the display. The dispersion of the displays was aggravated by the incorporation of source range neutron flux, radioactivity release rates and drywell high-range radiation parameters into the SPDS. For these reasons and to improve its capability to monitor entry conditions identified in future revisions of the reactor control, containment control, and radiation release guidelines of the EPG's, we are proposing to provide a new computer-based SPDS as part of the current program to upgrade the process computer. The new system will be operational prior to startup following the third refueling outage for both units 2 and 3 commencing after 1985. Based on our current outage schedule projections, the computer-based SPDS should be operational on Unit 2 by late 1989, and on Unit 3 by mid-1990.

As a result of the request for cost information at the June 14, 1984 meeting, we have determined that implementation of an SPDS independent of the process computer would add nearly 2 million dollars to the total cost of these modifications. The additional expense associated with incorporating the SPDS feature into the process computer is approximately 1/2 million dollars.

Design specifications are currently being developed for the new process computer. The vendor selection process will be completed by mid 1986. Equipment procurement lead times would dictate a 1988 delivery schedule. Installation of the new computer would not be expected to be complete until 1989, prior to the start of the third refueling outages. Additionally, modifications associated with Regulatory Guide 1.97, Appendix R, and control room panel enhancements should receive first priority during the next two refueling outages. Considering the overall logistics associated with the design, procurement, and installation of a new process computer, and the need to assure that the existing control room instrumentation will not be adversely impacted, the third refueling outage schedule appears to be the only option.

In the interval between now and the third refueling outage, we propose that the analog Peach Bottom SPDS serve as the interim system. Justification for acceptability of the analog system as the interim SPDS is as follows:

1. The system includes the key parameters needed by control room personnel for assessing whether abnormal conditions warrant corrective action by operators to avoid a degraded core. These parameters are based on the entry conditions for the reactor control, containment control,

and radioactivity release guidelines of the plant-unique emergency operating procedures and on the process parameters used in the Emergency plan to classify an event as an alert, site emergency, or general emergency.

2. The operators have been thoroughly trained on a simulator to respond to transients and emergency conditions using the analog SPDS and redundant instruments on other panels in the control room. Operator performance in the use of these control features during the simulator training exercises has demonstrated the effectiveness of the integrated Peach Bottom emergency response capability (emergency procedures, SPDS, non-SPDS control panels, operator training, and use of Regulatory Guide 1.97 instrumentation). To enhance the interaction of control room personnel in the response to a plant transient, the operators train on the simulator as a team, including the Shift Supervisors, Control Operator, Reactor Operator, and Shift Technical Advisor.

3. Following completion of the upcoming Unit 3 outage, all SPDS sensors will be environmentally and seismically qualified in accordance with our commitments to Regulatory Guide 1.97. For most variables, the instrument loops are treated as safety-related circuits.

In addition to the features described above, the following compensatory measures that are non-outage related will be implemented by December 31, 1985. Outage-related improvements will be deferred until the first planned outage of at least two weeks in duration, commencing after November 1, 1985.

1. The interim SPDS displays will be enhanced using human factors engineering principles to improve their identification on the control panels. Enhancements being considered include color-coded panel background or demarcations.

2. During a transient, the Shift Technical Advisor will be assigned the primary responsibility of monitoring the radioactivity release rate and communicating this information to the shift supervisor. This responsibility will be incorporated into the procedures.

Accordingly, we request a revision to the NRC Order, dated June 14, 1984, to accept the analog SPDS as the interim SPDS and establish an implementation schedule of the third refueling outage after 1985 for a computer-based SPDS.

Should you have any questions regarding this matter, please do not hesitate to contact us.

Very truly yours,

John S. Kemper

Attachment

cc: T. P. Johnson, Resident Site Inspector

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50-278

ATTACHMENT 1

OPERATOR RESPONSE TO PLANT TRANSIENTS AT THE PEACH BOTTOM ATOMIC POWER STATION

The Peach Bottom "TRIP" procedures are symptom based emergency operating procedures written in accordance with Revision 2 of the BWR Owners' Group Emergency Procedure Guidelines. When development of the "TRIP" procedures began in 1981, one of the primary objectives of the implementation program was to establish a consistent, coordinated operator response to plant transients based on the "TRIP" procedures. To accomplish this objective, several transient response strategies were evaluated in early 1982 by running exercises on the Limerick simulator using the new "TRIP" procedure along with several different crews of operators. The response strategy described below is based on evaluation of those simulator exercises and is the strategy currently in use at Peach Bottom.

The minimum control room crew that would be available to respond to a plant transient consists of a Shift Supervisor (SSV) who is a senior licensed operator, a Control Operator (CO) and an Assistant Control Operator (ACO), both of whom are licensed operators, and a Shift Technical Advisor (STA). Members of the crew are usually alerted to a transient condition by a verbal report from one of the crew members, the annunciation of an alarm, or the onset of a plant scram. Once alerted to the existence of a transient condition, crew members position themselves in the control room in accordance with Figure 1. The ACO and CO have primary responsibility for operating controls and monitoring parameters in their respective control room areas. The SSV is the overall coordinator of operator actions taken during the transient. As such, he is responsible for assuring that established procedures are followed and directs that action be taken by the ACO and CO in accordance with the appropriate "TRIP" procedure. He has primary responsibility for analyzing the condition of the plant based on his own observations and information relayed to him by the ACO, CO and STA. The SSV has the authority to direct an operator to leave his normal control room position temporarily to assist the other operator as required by the nature of the transient. The STA's primary purpose during the transient is to assist the SSV in determining the overall status of the plant. The STA is not assigned to a particular control room location but is free to enter all areas to independently verify plant parameters and monitor the operations of plant systems. He is responsible for reporting anomalies to the SSV as soon as they are observed.

For transients that do not immediately result in a reactor scram, the ACO and CO respond by performing "Immediate Operator Actions" as specified in the appropriate "Operational Transient" (OT) procedure. These immediate operator actions are designed to return the plant to a stable condition and avoid a plant scram. During certain transients, the success of these actions depends on how quickly they can be accomplished. For example, actions taken in response to decreasing reactor level must be taken prior to reaching the low level scram trip point. Therefore, it is assumed that the ACO and CO will not always be able to access the appropriate procedere and read the procedure steps; consequently, the "Immediate Operator Actions" are required to be memorized by the operators. While the ACO and CO perform the "Immediate Operator Actions", the SSV obtains the appropriate OT procedure from the "TRIP" procedure book located at the "TRIP" table and confirms that the required "Immediate Operator Actions" have been performed. The SSV may be assisted in this task by the STA.

If the ACO and CO were successful in restoring the plant to a stable condition and avoiding a plant scram, they are directed through the "Follow-up" steps of the OT procedure by the SSV. The "Follow-up" steps have been designed to analyze the cause of the transient and to return the plant to normal operation after a stable plant condition has been attained. These steps are generally not time dependent and therefore are not memorized by the operators but are done under the direction of the SSV after he has accessed the procedure.

If at any time a scram condition occurs, the OT procedures are immediately exited and the appropriate "TRIP" flow chart is entered. Entry conditions to the "TRIP flow charts are memorized by all crew members to assure entry into the appropriate flow chart. The two largest and most commonly used flow charts, "RPV control" and"Containment Control", are permanently located under plexiglass on the "TRIP" table to ensure easy access. All other "TRIP" flow charts are located in individual drawers directly below the "TRIP" table and are mounted on styrofoam for easy handling.

Upon receipt of an entry condition to a "TRIP" flow chart, the SSV will begin requesting information on plant parameters from the ACO and CO and will issue commands to these individuals based on steps in the "TRIP" flow charts. By making the SSV responsible for directing operator actions in accordance with the procedures, the ACO and CO are freed from the need to access and read the procedures while simultaneously attempting to operate systems and monitor plant parameters. This strategy also helps to assure that the SSV is aware of all actions taken in response to the transient.

Simulator exercises have shown that the efficiency with which a transient is handled by an operating crew is a function of how well crew members communicate with one another during a transient. A SSV that issues commands based strictly on his own observation of plant parameters may cause the CO and ACO to loose track of the overall condition of the plant and thereby reduce their understanding of the corrective action being taken. In addition, the plant parameters observed by the SSV may not be consistent with those observed by the ACO or CO and this problem can only be addressed if all members of the crew are aware of the parameters being used by the SSV. Because of this, communications among crew members is stressed during yearly simulator requalification exercises. CO's and ACO's are trained to inform the SSV whenever they take an action. For example, when the ACO moves the reactor mode switch to SHUTDOWN, he immediately notifies the SSV by calling out "Mode Switch to SHUTDOWN". This allows the SSV to mark this step as completed on the TRIP flow chart. If this information is not relayed back to the SSV automatically by the ACO, the SSV must ask the ACO if the task was accomplished in accordance with the "TRIP" flow chart.

ACO's and CO's are also trained to inform the SSV of plant parameter status by calling out the parameter, its value, and its trend whenever a parameter controlled by the "TRIP" flow charts is observed. For example, a typical parameter update from the ACO may be "Reactor Level, plus 35 inches and decreasing". This verbal communication of plant parameters is important because it gives all crew members instant access to the same plant status information, it allows individual crew members to compare parameter values displayed at various control room locations to identify discrepancies, and it keeps all members of the crew informed of the status of the plant without leaving their respective assigned control room locations. ACO's, CO's and STA's are further trained to update the SSV on changing plant parameter trends without being asked by the SSV thus increasing the probability that unconservative trends will be resolved in a timely manner.

The SSV issues commands and asks questions of the ACO and CO based on the status of plant parameters and the "TRIP" flow charts. Because of their format, questions and commands can be read directly from the "TRIP" flow charts. For example, a flow chart step might read, "Have any safety relief valves opened?". The SSV calls out the question and receives a response from the CO who has SRV position indication at this assigned panels. If the response is positive, the SSV would direct the CO to "Start Torus Cooling" in accordance with the next approprate flow chart step. This command would be issued to the CO since all RHR system controls are located in his area of responsibility. When he places torus cooling in-service, the CO will notify the SSV by calling out "B" Loop of RHR is on Torus Cooling". It should be noted that in many cases, the SSV can independently verify the accuracy of the response to his questions by simply looking at the control panel himself. He is able to do this because of his control location in the control room. In the example just cited, the position lights on the SRV's are easily seen from the "TRIP" table. However, the SSV is encouraged to request information from his ACO and CO even if he is able to obtain the information directly in order to receive confirmatory information and to allow the ACO and CO to understand the basis for the SSV's subsequent commands.

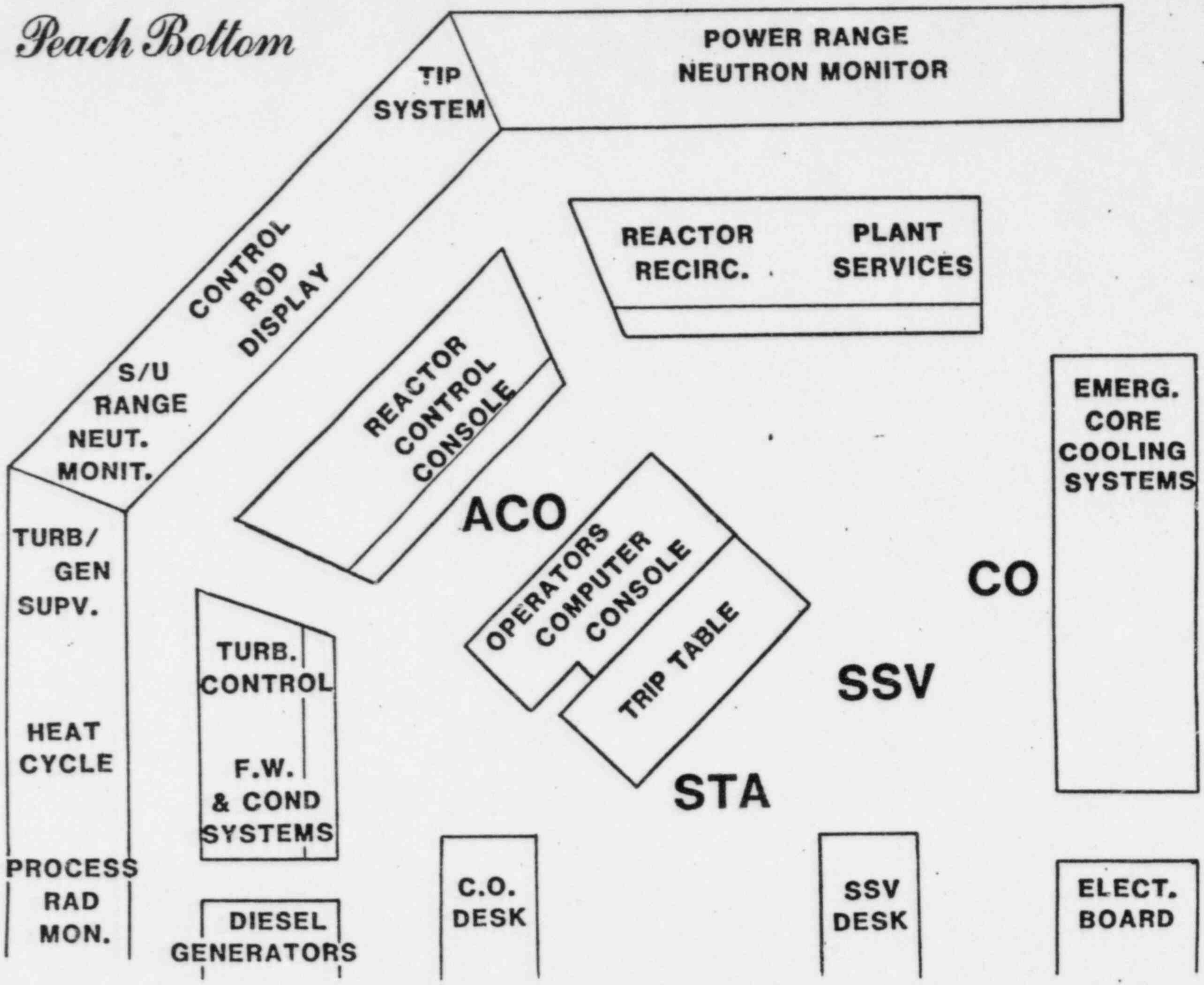
In order to highlight the importance of proper communications to each member of the crew, all crew members rotate control room assignments (e.g., SSV assumes role of ACO) during yearly simulator exercises. This allows each crew member to experience the communication needs of each control room position during a transient and keeps all operators familiar with the content of the "TRIP" procedures and flow charts.

During transients at Peach Bottom, the present SPDS system is used primarily by the CO to obtain data which is verbally transmitted to the SSV. The SPDS parameters displayed in the CO's area of responsbilitity are parameters which can be affected by systems under his control and these indications provide feedback to the CO when corrective actions are taken. A portion of the SPDS, the reactivity monitoring section, is positioned in the ACO's area of responsibility. As with the CO, the SPDS displayed in the ACO's area of responsibility is related to the plant parameter he is responsible for controlling. Because they can be directed by the SSV to any control room area, the total SPDS is available to both of these operators if required.

The SSV can obtain SPDS data either through verbal communication with the CO, ACO or STA, or by viewing the SPDS directly as required. Although direct access to the SPDS cannot be made by the SSV without temporarily leaving the "TRIP" table, the central location of SSV in the control room minimizes the time required to access the SPDS. The STA, because he is free to enter all control room areas at any time, can access the entire SPDS whenever required.

The transient response strategy described above has been in use at Peach Bottom since March of 1983 when the first revision of the "TRIP" procedures was issued to the control room. Since its initiation, this strategy in conjunction with the existing control room instrumentation has proven to be a very effective means of revolving plant transients in a safe and efficient manner.

Peach Bottom



ATTACHMENT 1
FIGURE 1

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