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ILLINOIS POWER

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Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Station Blackout (SBO) Safety Evaluation for Clinton Power Station, Response to the Station Blackout Rule 10CFR50.63, "Loss of All Alternating Current Power"

Dear Sir:

The purpose of this letter is to respond to the Nuclear Regulatory Commission (NRC) staff's safety evaluation, dated May 29, 1992, regarding the Clinton Power Station (CPS) response to the Station Blackout rule 10CFR50.63, "Loss of All Alternating Current Power."

The NRC's safety evaluation, which includes the Technical Evaluation Report (TER) prepared by the staff's consultant, Science Applications International Corporation (SAIC), documents the NRC's acceptance of CPS's response to the SBO rule 10CFR50.63 contingent upon CPS responding to several recommendations.

Most of the staff's recommendations were previously discussed by the NRC Licensing Project Manager for CPS and Illinois Power in telephone conferences held on October 31, 1991, November 8, 1991, and November 19, 1991. A description of the recommendations and the justifications for resolution are included in the attachment to this letter, including a schedule for completing those recommendations which are not yet complete.

The following is a summary of CPS's response to those recommendations which have not yet been completed. A more detailed response is contained in the attachment.

Condensate Inventory

The NRC recommendation on condensate inventory for decay heat removal stated that the licensee should implement measures to ensure that the suppression pool temperature remains below the limit established in the Emergency Operating Procedures (EOPs). CPS recognized the discrepancy between the limit established in

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the EOPs and the calculated value used for off-normal procedure CPS 4200.01, "Loss of AC Power". A limit was established in CPS 4200.01 to maintain reactor pressure to greater than 178 psig in order to prevent a conflict with the calculation in the SBO evaluation. This created an apparent conflict with the EOP Heat Capacity Limit (HCL) curve which requires emergency pressurization of the reactor pressure vessel when the suppression pool temperature reaches 175°F. The 178 psig limit in CPS 4200.01 is based on an overly conservative calculation which indicated suppression pool temperature would exceed its design limit in four hours if the reactor vessel was depressurized below 178 psig.

Operation in accordance with the EOPs is an analyzed scenario and the HCL curve is based on calculations which reflect industry guidelines for safe operation in emergency situations. A new calculation is being prepared for the SBO evaluation to indicate that the post-SBO suppression pool temperature will be several degrees lower than that predicted by the previous analysis. This calculation will be completed and procedural conflicts will be resolved by September 30, 1992.

Class 1E Battery Capacity

The TER stated that during an SBO, CPS will be unable to monitor drywell, containment and suppression pool temperatures without using portable testing equipment. Presently CPS is revising the "Loss of AC Power" procedure to include instructions for connecting and using available portable test equipment. This task is scheduled to be completed by September 30, 1992.

Inverter Room Ventilation

To implement the recommendations about loss of ventilation in the inverter rooms, CPS is revising heat-up calculations for the inverter rooms because of conservative errors found in calculating the room dimensions. The parameters of the initial temperature and heat load are also being revised. A more realistic initial room temperature will be used. The inverter heat loads used in the original calculations were overly conservative. More realistic loads will be used in the revised calculations by using the inverter efficiencies at the stated loads. This calculation is scheduled to be completed by September 30, 1992.

Control Room Ventilation

CPS's Station Blackout submittal proposed a modification to install an engine-powered fan to ventilate the control room during an SBO event. Justification for the main control room heatup analysis and for the basis of the conceptual design of the proposed modification is stated in the attachment. This modification, as part of the design process, will be subjected to a design review to confirm its adequacy. The modification is scheduled for design completion by June 30, 1993 and installation by May 29, 1994.

Quality Assurance (QA) and Technical Specifications

The TER questioned whether CPS is relying on non-safety-related equipment to cope with a Station Blackout. Regulatory Guide (RG) 1.155 requires that equipment relied upon to respond to an SBO be included in the QA program.

After reviewing the SBO evaluation, it was identified that CPS's evaluation establishes the number of safety relief valve (SRV) actuations necessary using the safety-related SRV accumulators and also the number of additional actuations that would be necessary using the non-safety-related backup compressed air bottles. To comply with the RG 1.155 requirements, CPS is completing an analysis to determine the number of SRV actuations needed to cope for four-hours in an SBO. The task is scheduled to be complete by September 30, 1992. The need to apply additional requirements on the backup air supply will be determined by the analysis.

All other recommendations either have been implemented or should be resolved by the justifications provided in the enclosed attachment.

With the exception of the control room ventilation modification, all recommendations will be completed by September 30, 1992. The modification to maintain adequate ventilation in the control room will be completed by May 29, 1994. Illinois Power will submit a supplemental letter by October 31, 1992 providing a status of those items expected to be completed by September 30, 1992.

Please contact me should you have any questions on this matter.

Sincerely yours,

R J Stevens for

F. A. Spangenberg, III
Manager, Licensing and Safety

SSG/alh

cc: NRC Clinton Licensing Project Manager
NRC Resident Office
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

I. CONDENSATE INVENTORY FOR DECAY HEAT REMOVAL

NRC Recommendation 2.3.1.1.a:

"The licensee should implement measures to ensure that the suppression pool temperature remains below its limit of 175°F as established in the EOPs".

CPS Response:

The Technical Evaluation Report (TER) identified an apparent discrepancy between the Emergency Operating Procedures (EOPs) and the off-normal procedure CPS 4200.01, "Loss of AC Power". CPS recognized the discrepancy between the EOPs and the calculated value used for off-normal procedure CPS 4200.01, "Loss of AC Power". A limit was established in CPS 4200.01 to maintain reactor pressure to greater than 178 psig to prevent a conflict with the calculation in the SBO evaluation. This created an apparent conflict with the EOP Heat Capacity Limit (HCL) curve which requires emergency depressurization of the reactor pressure vessel when the suppression pool temperature reaches 175°F. The 178 psig limit in CPS 4200.01 is based on an overly conservative calculation which indicated suppression pool temperature would exceed its design limit in four hours if the reactor vessel was depressurized below 178 psig.

Operation in accordance with the EOPs is an analyzed scenario and the HCL curve is based on calculations which reflect industry guidelines for safe operations in emergency situations. A new calculation is being prepared to indicate that the post-SBO suppression pool temperature will be several degrees lower than that predicted by the previous analysis. CPS discussed this issue with the NRC Licensing Project Manager in a telephone conference on November 19, 1991. The suppression pool heatup calculation will be completed and the procedural conflicts will be resolved by September 30, 1992.

NRC Recommendation 2.3.1.1.b:

"The licensee should verify that, if the RCIC storage tank water is used, the suppression pool water level would not exceed the maximum allowable level."

CPS Response:

The TER noted that CPS's submittal indicated that the preferred water source during an SBO would be the Reactor Core Isolation Cooling System (RCIC) storage tank, and did not consider whether the water injected that is dumped into the pool (approx. 65,000 gallons per the TER) would raise the pool above its limits. CPS provides justification for resolution of this issue as follows. Essentially, the level to which the suppression pool would be raised by adding the entire volume of the RCIC storage tank (125,000 gallons) is lower than the level to which dumping the upper containment pools would raise the suppression pool, and that condition has been analyzed in the preparation of CPS's EOPs. The details are as follows:

- The upper limit of the normal pool level is 19'-5".
- The 125,000 gallons equals about 16,700 ft^3
- Based on CPS Technical Specifications Section 3.6.3.1.a, adding 16,700 ft^3 to the suppression pool would raise the suppression pool level about 2'-2" to 21'-7". The value of 21'-7" is less than 21'-11", which is the value after an upper pool dump.
- The EOP provides no required action for a suppression pool level of 21'-7" (which would be the level based on the assumptions for an SBO transient.)

This issue was also discussed with the NRC Licensing Project Manager in a telephone conference on November 19, 1991, and he indicated that the NRC will consider this issue resolved.

CPS believes that no further action is required on this issue, and considers this recommendation closed.

II. CLASS 1E BATTERY CAPACITY

NRC Recommendation 2.3.2.1.a:

"The licensee should ensure that the last minute loading includes the same equipment that will be running before the last minute in addition to the equipment necessary to recover from the SBO event."

CPS Response:

In the telephone conference held on October 31, 1991, the NRC Licensing Project Manager asked whether the load calculation during the last minute of the SBO includes equipment running before the last minute of the event as well as the equipment required to recover. CPS replied that the only change which was made to the battery capacity calculation for the last minute was removing the RCIC gland seal compressor load. This change was made because the gland seal compressor is a large load on the system and needs to be shed to provide sufficient capacity to flash an Emergency Diesel Generator (EDG) field or close a breaker to an offsite power source at the end of an SBO event.

In the telephone conference with the NRC Licensing Project Manager on November 19, 1991, it was emphasized that the RCIC gland seal air compressor is the only load that is shed at the four hour mark and is required to be removed as stated in CPS Procedure 4200.01 at the end of the four hours.

The calculations, which verify that the battery is able to flash the EDG field and operate the breakers, specifically state that the recovery load includes the SBO loads (other than RCIC gland seal air compressor) at the end of the four-hour SBO coping period.

It was indicated by the NRC Licensing Project Manager that the NRC would consider this issue resolved by the information presented in

the telephone conference. CPS believes that no further action is required on this issue.

NRC Recommendation 2.3.2.1.b:

"The licensee should include RCIC loads in battery sizing calculations".

CPS Response:

The TER stated that in the battery sizing calculations, CPS assumed that RCIC battery loads would only be applied for 30 seconds. The TER stated that this appears to be inconsistent with the EOPs, which call for operation of RCIC with the high pressure core spray system as a backup. Also, RCIC starts automatically on a containment isolation signal and low reactor vessel water level, and the operator will not shut down the RCIC system unless instructed to do so by the EOP. The TER also indicates that the battery sizing calculations need to be revised to include the RCIC loads or to provide procedural steps as necessary.

There are two primary loads during RCIC operation: the gland seal air compressor and motor operated valve operation. Both of these loads are included in the battery calculation. The gland seal air compressor load is assumed from initiation of the SBO event until the time of recovery. Valve operation is included during the first minute of the event to establish valve lineup. For added conservatism, the calculation then includes operations of a RCIC motor operated valve every 30 minutes throughout the four hours of the event. Since the RCIC loads are included in the battery calculations, no further action is required on this issue.

NRC Recommendation 2.3.2.1.c:

"The licensee should provide information as to how the lighting will be provided to perform the needed actions."

CPS Response:

The TER stated that CPS is planning to shed emergency lighting at 60 minutes into the event, but did not identify what would be available in the absence of the emergency lighting or whether substitute lighting would be sufficient to support needed action.

In addition to the emergency lighting fed by the DC bus, CPS has battery pack lighting with a built-in battery and a built-in charger which is powered from the divisionally-fed AC standby lighting cabinets. The battery pack lighting comes on when the divisional power source is lost, as would be the case during a station blackout. As part of the CPS 10CFR50 Appendix R review, CPS determined that sufficient lighting is available for up to eight hours after power is lost to operate required equipment. Appendix R lighting is described in the USAR section 9.5.1 and Table 9.5-12.

Based on this justification for the adequacy of CPS's emergency lighting, no further action is required on this issue.

NRC Recommendation 2.3.2.1.d:

"The licensee should verify that both the Division I and Division II battery has sufficient capacity, taking into consideration the staff concerns in section 2.3.2".

CPS Response:

The TER indicated that an independent calculation estimated the Division I battery load for the first minute to be 722 amps. CPS's analysis indicates that the first minute load would be 564 amps. This issue was discussed with the NRC Licensing Project Manager in a telephone conference on November 8, 1991. CPS has analyzed the sequence/timing of loads that would come on during the first minute. The analysis showed that the maximum concurrent load during the first minute would be 564 amps. In accordance with the applicable standard, this load was then applied for the full first minute. It should be noted that if all the loads that existed during the first minute were summed, the total would be on the order of 720 amps. However, CPS's analysis shows that they are not energized concurrently and justifies the use of 564 amps.

In the battery capacity analysis, CPS used a design margin of 1.0. The TER stated that this is inconsistent with Institute of Electrical and Electronics Engineers (IEEE) Standard 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations", which recommends a design margin of 1.1 to 1.15.

The purpose of the battery calculations was to determine the adequacy of the existing divisional battery to supply the defined loads for the duration of the SBO. The calculations were not being used to select a new battery. As such, the design margin of 1.0 means that new loads cannot be added without the calculation being revised. When the calculation is performed in this manner, the value shown under "battery capacity remaining" represents the "design margin" of the existing battery.

IEEE 485 is used when selecting a battery. A design margin value of 1.1 to 1.15 provides for new loads added by future design changes. It is not applicable to the SBO battery calculations, which evaluate an existing configuration.

When the plant was designed and built, the IEEE design margin was used, but as loads were added (through design changes controlled by the configuration management procedures), the design margin was reduced. During the third refueling outage (completed in spring 1992), CPS replaced the Division I battery with a larger capacity unit, and there are plans to similarly replace the Division 2 battery in refueling outage 5 or 6 which will then restore its original design margin.

The TER questioned whether the inverter loads (AC amps) are for SBO loads or normal loads after the event. The TER further states that it assumes that the continuous inverter current used by the licensee is based on the maximum current which is drawn when the battery terminal voltage is at its lowest level during the SBO event.

CPS's response is that there are no "SBO" inverter loads. The loads on the inverter during an SBO are the same loads that the inverter supplies during normal operation. The inverter input current used in the calculations is indeed the current that the inverter would draw with its input terminal voltage at 105V. The justification for CPS's inverter loads was discussed with the NRC Licensing Project Manager in a telephone conference on November 19, 1991, and he indicated this justification appears to be acceptable.

The TER stated that during an SBO, CPS will be unable to monitor drywell, containment and suppression pool temperatures without using portable testing equipment. These parameters are important to have available to alert operators about potential leakage. Presently, CPS is revising procedure CPS 4200.01 to include instructions for connecting and using the portable test equipment. It is expected that this task will be completed by September 30, 1992.

III. EFFECTS OF LOSS OF VENTILATION IN THE RCIC ROOM AND STEAM TUNNEL

NRC Recommendation 2.3.4.1.1.a:

"The licensee should verify that the RCIC turbine steam supply valve will be able to close should the containment isolation become necessary during an SBO event."

CPS Response:

The TER questioned whether the motor-operated RCIC steam supply valve would be able to close during an SBO event because of the high temperature (223°F) predicted in the main steam tunnel. The containment isolation assessment performed in 1989 stated that the AC-powered RCIC outboard containment isolation valve is normally open and will fail as-is during an SBO. The assessment also stated that the valve needs to be left open in order to keep the RCIC pump available for injection into the reactor pressure vessel. An Appendix to the "Loss of AC Power" procedure, CPS 4200.01, provides this guidance to the operator. The basis for leaving the valve open is to allow RCIC to remain operable during an SBO. DC-powered, motor-operated valves downstream of this valve and accessible in the RCIC room can be used to isolate this line, if necessary, since no pipe breaks are required to be postulated during an SBO. In addition, from an environmental qualification perspective, the RCIC outboard containment isolation valve is qualified for temperatures over 300°F, which is well above the calculated steam tunnel temperature. This assures that the valve could be operated when power was restored.

IV. INVERTER ROOM

NRC Recommendations 2.3.4.2.1.a and 2.3.4.2.1.b:

"For the temperature of 80°F used as initial temperature in the heatup calculation to be acceptable, the licensee should have or establish an administrative procedure to ensure that this temperature would not be exceeded during normal power operation or use the maximum allowable temperature for these rooms."

"For the heat load in the room due to the inverters, the licensee should verify that it has used an inverter efficiency loss consistent with the expected inverter load, or use a constant efficiency loss based on the rated capacity of the inverter."

CPS Response:

The TER indicated that the heatup calculations for the inverter rooms are not conservative. CPS indicated that the initial temperature would be 80°F. The TER questioned the controls in place to make sure that the temperature is maintained at 80°F or below. Also, the TER questioned whether CPS used an inverter efficiency loss consistent with the expected inverter loads or whether CPS used a constant efficiency loss based on the rated capacity of the inverter when heat loads in the inverter room were calculated.

These calculations are in the process of being revised because of errors found in calculating the room dimensions. The inverter room initial temperature and heat load are being revised. A more realistic initial room temperature will be used. The inverter heat loads used in the original calculations were overly conservative. More realistic loads will be used in the revised calculations by using the inverter efficiencies at the stated loads. It is expected that this calculation will be completed by September 30, 1992.

V. CONTROL ROOM

NRC Recommendation 2.3.4.3.1.a:

"The licensee should re-perform its control room heat-up analysis taking into account the non-conservatisms as identified in the attached TER and verify the prior conclusion that the control room temperature would not exceed 120°F."

CPS Response:

The TER indicated that in the heat-up calculations for the main control room, CPS has used the initial outside temperature of 96°F. The contractor's review of the Updated Safety Analysis Report (USAR) found that the maximum temperature recorded in Springfield was 112°F and the maximum temperature in Peoria was 103°F. Using data from

NUREG/CR-1390, the annual maximum temperature for the 50-year period at the CPS site was 111°F. The contractor's conclusion is that CPS should have used 111°F rather than 96°F.

The American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) design tables (in 1989 ASHRAE Handbook, Fundamentals, I-P Edition, Atlanta, 1989) provide 96°F as the outside air temperature to be used in designing air conditioning systems in this area of Illinois. This was used as the basis for choosing this temperature for this calculation. This is in accordance with the design basis for the main control room ventilation system (VC) as provided in the design criteria for that system.

The TER questioned the initial temperature of 73°F used in the main control room heatup calculation instead of the 86°F specified in the Technical Specifications. The following justification supports 73°F as the initial temperature:

- The main control room temperature controller is set at 73°F;
- CPS's USAR section 9.4.1.3 states that the main control room temperature will be automatically controlled at 73°F +/- 2°F;
- For operation outside the temperature band, a malfunction of the temperature controller would be required;
- Malfunctions of major components in the VC system are annunciated in the main control room, such as a fan trip or a high differential pressure on a filter or damper; and
- Annunciation will precipitate operator actions such as switching to an operable train and initiating a maintenance work request.

The TER said that CPS indicated that the heat load per person was 255 BTU/hr (approx. 75 watts/person). However, the TER expressed the opinion that the ASHRAE handbook recommends a heat load of approximately 250 watts/person.

CPS has reviewed the ASHRAE tables on occupant heat load. The value suggested in the TER corresponds to a person doing strenuous exercise. The tables indicate that a sensible heat load of 255 Btu/hr per person is an appropriate value for persons performing moderate exertion.

All these issues about the main control room ventilation were discussed with the NRC Licensing Project Manager in a telephone conference on November 19, 1991. This justification should resolve these issues.

VI. CONTAINMENT ISOLATION

NRC Recommendation 2.3.5.1.a:

"The licensee should establish an appropriate procedure to list the CIVs which are either normally closed or normally open, fail as-is upon loss of ac power and cannot be excluded by the criteria given in

RG 1.155, and identify the actions necessary to ensure that these valves are fully closed, if needed. The valve closure should be confirmed by position indication."

CPS Response:

RG 1.155 provides criteria that allow the licensee to exclude certain containment isolation valves (CIVs) during an SBO. The TER stated that some of the valves (e.g., residual heat removal system shutdown cooling, low pressure core spray system suction, etc.) that CPS excluded may not meet the exclusion criteria. The TER further states that the licensee needs to: list in an appropriate procedure the CIVs which are either normally closed or open, fail as-is upon loss of AC power, and cannot be excluded by the criteria given in RG 1.155; and identify the actions necessary to ensure that these valves are fully closed, if needed. Also the valve closure needs to be confirmed by some kind of position indication.

CPS has added to CPS procedure 4200.01 a list of valves that would require manual operation if containment isolation is needed during an SBO.

CPS has further reviewed the analysis for containment isolation. CPS did not exclude any valves from consideration that are not allowed to be excluded by RG 1.155. CPS has also included the list of valves that may need to be operated during an SBO in CPS procedure 4200.01. In CPS's containment isolation analysis, it was confirmed that these valves have local stem position indication. Portable hand-held lighting is available and would be used to provide lighting for confirming valve position during an SBO. This justification of CPS's containment isolation capability is considered adequate and no further action is required.

VII. PROPOSED MODIFICATION

NRC Recommendation 2.5.1.a:

"The licensee should reevaluate the adequacy of the proposed fan after taking into consideration the staff concerns discussed in Section 2.3.4.3 pertaining to the effects of loss of ventilation in the control room. The licensee should include a full description of the fan installation and how is meets the guidelines of Appendix B of NUMARC 87-00 in the documentation that is to be maintained by the licensee in support of the SBO submittals."

CPS Response:

As discussed in the response to NRC recommendation 2.3.4.3.1.a, the values of input parameters used by CPS to perform the control room heat-up analysis are adequate and were accepted verbally by the NRC Licensing Project Manager in a telephone conference on November 19, 1991.

CPS's SBO submittal proposed an engine-powered fan to ventilate the control room during a station blackout event. Since CPS has presented adequate and acceptable justification for the control room heatup analysis, the basis for the conceptual design is sound. However, this modification, as part of the design process, will be subjected to a design review to confirm its adequacy. It is expected that the modification will be designed by June 30, 1993 and installed by May 29, 1994.

VIII. QUALITY ASSURANCE (QA) AND TECHNICAL SPECIFICATION (TS)

NRC Recommendation 2.6.1.a:

"The licensee should verify that the SBO equipment is covered by an appropriate QA program consistent with the guidance of RG 1.155."

CPS Response:

The TER questioned whether CPS is relying on any non-safety related equipment to cope with a station blackout. RG 1.155 requires that equipment relied upon during an SBO be included in the QA program. CPS did not provide any statement in the submittal concerning this.

After reviewing the SBO evaluation to respond to the concern, CPS identified that the evaluation establishes the number of safety relief valve (SRV) actuations necessary using the safety-related SRV accumulators. CPS's evaluation also establishes the number of additional actuations that would be necessary using the non-safety-related backup compressed air bottles. However, the evaluation does not establish the number of actuations that would be needed during an SBO. If the backup air bottles are needed, then CPS will assure that the compressed air bottle system is included in its QA program in order to comply with the RG 1.155 requirements. CPS is currently performing an analysis to determine the number of SRV actuations needed for a four-hour SBO. Preliminary results indicate that the backup air bottles will not need to be included in the QA program to comply with the RG 1.155 requirements. It is expected that the evaluation will be complete by September 30, 1992.

IX. EDG RELIABILITY PROGRAM

NRC Recommendation 2.7.1.a:

"The licensee should implement, for its Division I, II and III EDGs, an EDG Reliability Program which meets the guidance of RG 1.155, section 1.2. If an EDG reliability program currently exists, the program should be evaluated and adjusted in accordance with RG 1.155."

CPS Response:

The TER stated that CPS chose an Emergency Diesel Generator (EDG) target reliability of 0.95 based on EDG data for only 20 starts. It

was questioned why CPS did not use data for 50 or 100 starts. It was also questioned whether CPS's present reliability data would support the chosen EDG target reliability.

At the time CPS submitted responses to the SBO rule to the NRC, CPS was a relatively new plant and only had approximately 25 starts on each diesel. The choice was appropriate based on the Nuclear Management and Resources Council (NUMARC) methodology. This target reliability is still appropriate.

In determining the coping capability for CPS (4 hours), a target reliability level of 0.95 was chosen. In the NUMARC 87-00 methodology, a target reliability of 0.95 could be chosen based on having a reliability >0.90 in the last 20 starts. This was the basis for CPS's choice. Other bases that could be used were 50 and 100 starts. However, at the time this calculation was performed, there were only enough starts to use the 20 start basis. CPS's reliability for the last 20 starts is still above the 0.90 level.

The EDGs have experienced no failures in the last 20 or 50 starts and one failure in the last 100 starts. The data was compiled in accordance with the criteria in NUMARC 87-00 Appendix D, and the data is for all three EDGs combined, which meets the NUMARC guidance. The current data compares very well with the trigger values in NUMARC initiative 5A (i.e., three in 20 starts, five in 50 starts and eight failures in the last 100 starts for a plant with a 0.95 target reliability).

CPS's EDG reliability program has incorporated the guidance in Appendix D of NUMARC 87-00. This justification was provided to the NRC Licensing Project Manager in a telephone conference on October 31, 1991. He verbally indicated that the issue was considered resolved with no further actions or information required.