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July 23, 1985
RFW-0561

Mr. John A. Zwolinski, Chief
Operating Reactors Branch #5
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Zwolinski:

Subject: Oyster Creek Nuclear Generating Station
Docket No. 50-219
Isolation Condenser Vent Installation

References:

1. Letter from USNRC to GPUN, "Schedular Exemption-Compliance with 10CFR50.44(c)(3)(iii) - Isolation Condenser High Point Vents", August 9, 1984.

2. Letter from GPUN to USNRC, "Isolation Condenser Vent Installation", May 8, 1984.

3. Letter from GPUN to USNRC, "Isolation Condenser Vent Installation", March 27, 1984.

4. Letter from USNRC to GPUN, "Isolation Condenser Vent Installation", January 17, 1984.

5. Letter from GPUN to USNRC, "Final Rule on Interim Requirements Related to Hydrogen Control - Exemption Request dated August 2, 1982", December 15, 1982.

6. Letter from GPUN to USNRC, "Final Rule on Interim Requirements Related to Hydrogen Control - Exemption Request", August 2, 1982.

The previous correspondence on the Isolation Condenser Vent Installation at the Oyster Creek Nuclear Generating Station consists of the above references. The licensee's letter of August 2, 1982 (reference 6), as supplemented on December 15, 1982, March 27 and May 8, 1984 (references 5, 3, and 2), requested a schedular exemption in order to defer this installation until the end of the Cycle 11 refueling outage. By letter dated August 9, 1984 (reference 1), Oyster Creek was granted a schedular exemption based on a staff evaluation which concluded that the deferment of the installation of the vents on the Isolation Condenser would not adversely affect plant operation.

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The purpose of this letter is to request an exemption from the compliance requirements of 10CFR50.44(c)(3)(iii) and to provide justification for GPUN's decision to cancel this modification. This justification consists of new information which demonstrates that venting of the Isolation Condensers to the torus is not necessary for design basis LOCA events, and that for beyond design basis LOCA events, Isolation Condenser venting could benefit Oyster Creek performance only in certain small breaks which also involve the failure of the Automatic Depressurization System. This benefit would be a small reduction in the risk of core damage and would be insignificant in comparison with the NRC specified value for Plant Performance Guideline for such risk.

This new information is summarized in the attachments to this letter. Attachment I consists of the Evaluation of Need for Isolation Condenser Venting in LOCA Mitigation. Attachment II consists of a Risk Assessment which demonstrates that the frequency of core damage resulting from LOCA events which could require venting of the isolation condensers is less than the NRC Plant Performance Guideline for core melt.

These attachments comprise the basis for GPUN's decision to cancel the Isolation Condenser Vent Installation which had been scheduled for the Cycle 11 refueling outage. It is therefore requested that an exemption be granted to GPUN relative to the requirements of 10CFR50.44(c)(3)(iii) which pertain to the installation of Isolation Condenser High Point Vents at the Oyster Creek Nuclear Generating Station.

If you have any questions or require any additional information please contact M.W. Laggart, Manager, BWR Licensing at (201) 299-2341.

Very truly yours,

R. F. Wilson
Vice President and Director
Technical Functions

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Attachments

cc: Administrator
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NRC Resident Inspector
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ATTACHMENT I

EVALUATION OF NEED FOR ISOLATION CONDENSER VENTING IN LOCA MITIGATION

I. Background and Introduction

NUREG-0737 Item II.B.1 and 10CFR50.44(c)(3)(iii) includes a requirement to provide "high point vents for systems required to maintain adequate core cooling if accumulation of non-condensibles would cause the loss of function of these systems." In being responsive to this requirement as applied to the Isolation Condensers (IC) in Oyster Creek, GPUN initially planned to install high point vents from the tube side of the IC's to the torus. This project was to be performed in the Cycle 10 refueling outage. Subsequently, due to other higher priority work, it was decided to defer the project until the Cycle 11 refueling outage. The justification for the deferral was made on the basis of the perceived safety risk of deferral being acceptably small. This justification became the basis for which the NRC granted a schedular exemption until the Cycle 11 refueling outage.

Presently GPUN is considering cancellation of the IC to torus vent installation. The justifications for cancellation are similar to those used for the deferral from Cycle 10 to Cycle 11 refueling outage.

II. Scope of Evaluation

This evaluation addresses the need for IC operation for LOCA mitigation including long term post-accident cooling. Accordingly, this evaluation is limited to consideration of only those loss of coolant events in which successful reactor scram occurs early in the event. Further, to be consistent with the intent of 10CFR50.44(c)(3)(iii), both design basis LOCA events (DBA's) and beyond design basis LOCA events are discussed. However, to be more meaningful in responding to the 10CFR50.44(c)(3)(iii), the impact on LOCA Mitigation of the IC venting is evaluated as opposed to evaluating the impact of the overall IC availability itself. In other words, the difference in LOCA Performance with the IC function continuously available (by venting of non-condensibles if required) is evaluated in comparison with LOCA performance with IC function initially available but postulated to be lost due to the inability to vent any expected accumulation of non-condensibles. Also such a loss of IC function is considered to occur only after the core is uncovered for significant periods of time without effective cooling such as by core spray. This is because the only credible mechanisms for generation of non-condensible gases is considered to be metal water reaction in the core or release of fission gases by cladding failure. These two mechanisms would not be significant if the core remains effectively cooled by coverage or core spray.

Previously documented LOCA Performance for Oyster Creek was used as a basis to evaluate the benefit of IC venting in LOCA mitigation. These include the currently docketed reload submittal, NEDO-24195, the analytical results of OC LOCA response documented in NEDO-24708A and the recent evaluation of core damage frequency estimates contained in Attachment II of this letter. No new LOCA response analysis was performed for this evaluation.

III. Discussion

A. Isolation Condenser Function

The normal function of IC's occurs following a reactor isolation when they provide a means of removing decay heat and cooling the reactor below 350°F such that the Shutdown Cooling System can be initiated. Their function will be automatically initiated in loss of coolant events and will affect the reactor response in the following manner:

(1) It will aid the depressurization of the reactor occurring by other means such as the break flow or the operation of the Automatic Depressurization System (ADS). This has the effect of hastening the availability of low pressure coolant makeup and also reducing coolant loss through the break (due to lower reactor pressure).

(2) By returning the coolant condensed on the tube side (rather than being lost through the break) it helps to conserve reactor coolant.

OC has two IC's each with heat removal capacity at normal reactor pressure of about 3% of rated reactor power. In terms of reactor depressurization capability this heat removal from each IC is equivalent to the capability of about one quarter of an ADS valve or that of a steam break of about 0.025 ft^2. In terms of coolant conservation, each IC is equivalent to about 450 GPM of makeup at normal reactor pressure. This is equivalent to the initial coolant loss through a liquid break of approximately 0.0075 ft^2. The heat removal capacity of the IC's is lower at lower reactor pressure.

From the above discussion it is seen that the effect of IC operation in loss of coolant events will be significant only when the following conditions are present.

° Reactor pressure is sustained high.

° Fast depressurization mechanisms (such as by intermediate or large size break or by the ADS valves) are not present.

Further the difference in LOCA performance with and without the ability to vent the IC will be significant for events in which, in addition to the above, core uncovery without effective cooling by other means (such as core spray) occurs for significant periods of time to cause release of non-condensibles.

B. Design Basis LOCA Events

These are LOCA events which are used as a basis for the reactor design and for the determination of fuel heat generation limits for licensing purposes. As specified in the 10CFR50.46, they comprise the combination of the worst break (i.e., a break of the worst size at the worst location) and a worst single active failure.

For Oyster Creek a postulated DBA defined as above would have the ADS (with at least 4 valves) and two core spray loops available for LOCA mitigation. Analyses of these LOCA events show that the reactor will be depressurized and effective core cooling (by coverage for small bottom breaks and all top breaks or by continuous spray for large bottom breaks) will be established without significant release of non-condensibles. Also, since the ADS system is available, the reactor pressure would remain near the containment pressure level. Therefore the venting of the IC's would be immaterial to mitigation of design basis LOCA events.

C. Beyond Design Basis LOCA Events

These are loss of coolant events in which failures beyond the single failure requirement of DBA are postulated. Reactor response in these events is not factored into the determination of LOCA licensing fuel limits. Rather, these events are studied in terms of their contribution to an estimated probabilistic risk of core damage (also termed core damage risk or core damage frequency) with the objective of reducing such risk to acceptable levels. The value of IC venting in these beyond design basis LOCA events was evaluated in terms of its beneficial impact in reducing the calculated core damage risk. For proper perspective, this impact was compared to the NRC stated Plant Performance Guideline for core melt which has a value of 10^{-4}/reactor year. In this evaluation, reactor LOCA response studies previously documented in NEDO-24708A and the core damage frequency estimates reported in Attachment II of this letter were used as a basis.

A review of the results of evaluations contained in these references leads to the following conclusions about the value of IC venting in the mitigation of beyond design basis loss of coolant events.

1. IC venting is immaterial to mitigation of the following loss of coolant events.

1.A. Events initiated by breaks of any size above the core

In this case one or two IC's, if initially available, can depressurize the reactor even if ADS function is not available, and core overheating can be prevented by Core Spray or feedwater injection (and therefore significant release of non-condensibles can be avoided). Of course, if the ADS function is available, IC venting is not essential to mitigation as discussed in Section III.B above.

1.B. Events initiated by breaks below the core

1.B.1 Events initiated by breaks of any size in which ADS function is available: In this case, the ADS function can depressurize the reactor such that core overheating can be prevented by Core Spray injection.

1.B.2. Events in which ADS function is not available: In this case, the effect of break size is important. For breaks smaller than about 0.005 ft^2, the coolant loss through the break is sufficiently small such that one or two IC's, if initially available, can depressurize the reactor and core overheating can be prevented by Core Spray injection. For breaks larger than 0.005 ft^2, the coolant loss through the break is larger so that depressurization by just the IC function may not be sufficient. However, if the break is sufficiently large (greater than about 0.08 ft^2) the combined depressurization due to break flow and one or two IC's can prevent core overheating with Core Spray injection. (If the break is larger than about 0.1 ft^2, the break flow itself can provide the required fast depressurization even without IC function).

2. From the above it can be seen that IC venting would impact mitigation only in those loss of coolant events with below core breaks of 0.005 - 0.08 ft^2 size range in which the ADS function is not available either by automatic initiation or by timely manual operator action. In these events core overheating and release of non-condensibles could occur even if one or two IC's are initially available. Venting can then provide an opportunity to the operator to prevent any possible loss of IC function due to the non-condensibles and thus IC venting can contribute to limiting core damage. However, it should be noted here that manual ADS initiation

would be a more effective operator action than venting of IC's since the ADS depressurizes the reactor much more rapidly and terminates the LOCA event earlier with Core Spray injection.

3. The core damage frequency due to loss of coolant events described in 2 above was conservatively estimated in Attachment II of this letter to be about 1.8×10^{-5}/reactor year if no credit is taken for manual initiation of the ADS. The core damage frequency estimate would be reduced by a factor of ten (to about 1.8×10^{-6}) if manual operation of the ADS is considered. Inclusion of this manual action is deemed to be appropriate in assessing core damage frequency since the proposed IC venting would also rely upon manual initiation by the control room operator. Thus the reduction in core damage risk provided by IC venting in loss of coolant events would be even smaller than this value. In comparison with the NRC specified Plant Performance Guideline value for core melt of 10^{-4}, this benefit from IC venting is sufficiently insignificant that the IC to torus venting is not necessary for LOCA mitigation.

IV. Conclusions

Venting of the IC does not impact mitigation in design basis LOCA events since ADS function is available in these events. In beyond design basis LOCA events IC venting could be of benefit in reducing overall core damage risk by a small amount. This benefit is conservatively estimated to be about 1.8×10^{-5} per reactor year or 1.8×10^{-6} per reactor year with manual initiation of ADS. In comparison with the NRC stated Plant Performance Guideline value of 10^{-4}, the benefit is sufficiently insignificant to conclude that the plant modification to vent the IC's to the torus is not necessary for the mitigation of loss of coolant events at Oyster Creek.

V. References

NEDO-24195, "General Electric Reload Fuel Application for Oyster Creek", April 1984.

NEDO-24708A, "Additional Information Required for NRC Staff Generic Report on Boiling Water Reactors", Rev. 1, Aug. 1979.

ATTACHMENT II

Assessment of Core Damage Frequency for LOCA Events That Could Require Venting of the Isolation Condensers

INTRODUCTION

The issue of non-condensible gases affecting the operation of the isolation condensers was raised in NUREG-0737. It was part of the more general concern following the TMI-2 accident that the effective core cooling needed to prevent a severe core damage accident from progressing to a core melt might be hampered by the non-condensible gases generated early in the accident scenario.

This study determined the frequency of sequences in which isolation condenser performance might be adversely affected by the accumulation of non-condensibles, and in which if adequate isolation condenser performance could be assured, core melt might still be prevented. The sequences that meet this criteria are certain small below-core LOCAs with failure of ADS leading to delayed core spray injection. Delayed core spray injection results in excessive cladding temperatures and the generation of non-condensibles due to metal-water reaction. Continued isolation condenser operation would succeed in depressurizing the reactor vessel to the point where core spray injection would occur, terminating the accident.

RISK ASSESSMENT

This evaluation considers the importance of the ability to vent non-condensibles on the performance of the Oyster Creek Isolation Condensers (IC's), based on the core melt frequency due to small break LOCAs. The following guidelines were established for the evaluation:

BREAK SIZE (ft^2)	CRITERIA
.005 - .06	1 or 2 IC's may help mitigate the LOCA and could require venting of non-condensible gases.
.06 - .08	1 IC may help mitigate the LOCA and could require venting.
	2 IC's may help mitigate the LOCA and would not require venting
.08 - 0.1	1 or 2 IC's may help mitigate the LOCA and would not require venting.

Two LOCA initiators (small break below the core, inside and outside containment) were selected from the Oyster Creek Probabilistic Safety Analysis (OPSA). The Event Sequence Diagrams and Event Trees (which are modified versions of the ones in OPSA) are attached for your information. The symbols used in constructing Event Sequence Diagrams (ESD's) are shown in Figure 1. Each event sequence is comprised of successes and failures of various systems, subsystems, and components which lead to a stable condition or to a core damage state. In text describing an ESD, functions or blocks may be referred to by their two letter designation (found in the lower left corner of the block). That is, AD represents the success of the ADS, $\overline{AD}$ represents the failure of ADS.

Small break LOCA below core outside containment

1. Break size .005 - .06 ft^2.

   Figure 2 is the ESD for a small break below core outside containment. The following path of interest to IC venting is defined by this ESD:

   a. Break is not isolated ($\overline{IB}$)

   b. Reactor scram is successful (RS)

   c. ADS fails ($\overline{AD}$) and transfers down to isolation condenser event block.

   d. Beta success path is followed to the Reactor vessel internals remain coolable event block (IC, VC). Success of event IC requires one of the two condensers to be lined up to provide natural circulation cooling and depressurization of the reactor vessel.

   e. Success paths are followed to the CRD flow event block (CS, RV).

   f. From this block, three different sequences (CR; or $\overline{CR}$, FW; or $\overline{CR}$, $\overline{FW}$, FP) can lead to stable decay heat removal conditions.

These three sequences appear on the right side of the Event Tree in Figure 3 as Sequences 9, 10, and 11. The sum of the three sequences is 2.92 X 10^{-5} events per reactor yr, which represent the mean frequency for sequences that may require venting the isolation condenser. However, this value must be adjusted for the break size used in the analysis. The original Probabilistic Safety Analysis used break sizes from .005 - 0.1 ft^2. Since we are dealing with an upper bound value of .06 ft^2, a correction factor of .06/0.1 = 0.6 can be applied to the initiating event frequency for this LOCA category. This translates to a direct effect through the event tree to the final success or stable state blocks. Therefore, the frequency corrected for break size is:

$2.92 \times 10^{-5} (0.6) = 1.75 \times 10^{-5}$ events per reactor yr.

2. Break size .06 - .08 ft.^{2}

For this range of breaks, if only one isolation condenser is available it could require venting for successful operation. The System success criteria must be modified to consider the effect of two isolation condensers (which would be available in many situations) and, which in this case should not be included when considering venting capability. The sum of Sequences 9, 10, and 11 for two out of two isolation condensers is 2.88×10^{-5} events per reactor yr. Therefore, the mean frequency for sequences with only one condenser can be expressed as the difference between 1/2 isolation condensers and 2/2 isolation condensers (corrected for upper bound break size):

$$[(2.92 \times 10^{-5}) - (2.88 \times 10^{-5})] \frac{(.08 - .06)}{0.1} = 8.0 \times 10^{-8} \text{ events per reactor yr.}$$

Small break LOCA below core inside containment

1. Break size .005 - .06 ft^2

Figure 4 is the ESD for small break below core inside containment. The following path is described to reach the stable state condition:

a. Reactor scram and Internals remain coolable blocks are successful (RS, VC).

b. ADS actuation and Feedwater flow blocks fail ($\overline{AD}$, $\overline{FW}$)

c. Isolation condenser follows the success path to Suppression pool integrity maintained event block (IC).

d. The remaining event blocks are successful and lead to stable decay heat removal (SP, CS, FC, DS; then LT or $\overline{LT}$, FP)

This event path appears as Sequences 25 and 26 on the Event Tree in Figure 5. The mean frequency for these sequences is 6.44×10^{-8} events per reactor yr. Applying the correction for break size yields the following value:

$$6.44 \times 10^{-8} (0.6) = 3.86 \times 10^{-8} \text{ events per reactor yr.}$$

2. Break size .06 - .08 ft.^{2}

Separate cases were not available for two out of two isolation condensers for this LOCA initiator. However, as a conservative estimate we can apply the same frequency value determined in item (1) above corrected for this break range:

$$6.44 \times 10^{-8} (0.2) = 1.29 \times 10^{-8} \text{ events per reactor yr.}$$

CONCLUSION

The following table summarizes the frequency for LOCA events that could require venting of the isolation condensers to alleviate core damage.

	EVENTS PER REACTOR YR.
Small break below core outside containment	1.76×10^{-5}
Small break below core inside containment	5.15×10^{-8}
TOTAL	1.77×10^{-5}

This value is less than the NRC Plant Performance Guideline for core melt of 10^{-4} per year of reactor operation.

This analysis contains several conservatisms in both the risk analysis and thermal-hydraulic analysis assumptions. Among the important conservatisms are:

(a) No credit was given for the operator manually initiating ADS in the outside containment break scenarios. Given the procedures now used at Oyster Creek, there is reasonable assurance that he would depressurize the vessel quickly to hasten core spray injection. A 0.9 probability of successful operator action would reduce the frequency calculated above by a factor of 10.

(b) No credit was given for the operator using the existing vent to the main steam line. Use of that vent during an accident would be as effective as the proposed vent to the torus in preventing degradation of isolation condenser performance; it would however result in some increase in off-site doses. This increase would be due primarily to noble gases. This event should be considered a small contributor to risk because the existing 3/4 inch vent line would introduce a low flow rate into the large volume of the main steam lines, with little pressurization to increase leakage and contribute to off-site release. The main steam system is expected to remain intact (low leak rate) for most accident sequences. Plate-out of iodines and particulates would be experienced in the isolation condenser, in the vent line, and on the large surface area of the 24 inch main steam lines. Only noble gas would be available to be released to the environment.

(c) While the choice of break sizes and scenarios in the analysis is based on "best estimate" rather than Appendix K LOCA analysis, some degree of conservatism undoubtedly remains. It is probable that many of these breaks would not produce sufficient non-condensibles, and transport them to the isolation condensers, to hamper isolation condenser operation.

Based on both the results of this analysis and consideration of the conservatisms included in it, we do not believe that lack of an isolation condenser vent to the torus represents a significant risk to the public.

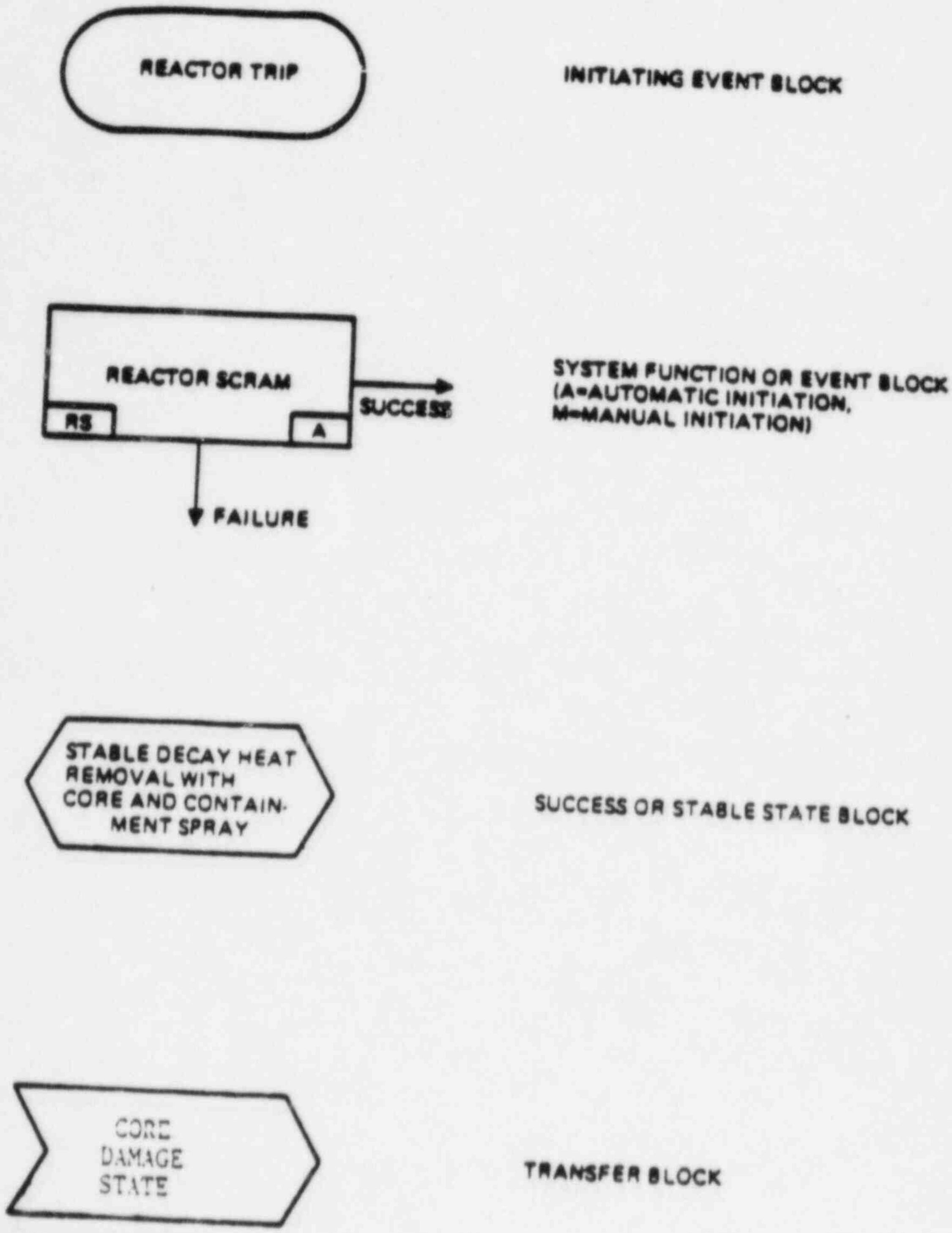

FIGURE 1. EVENT SEQUENCE DIAGRAM SYMBOLS

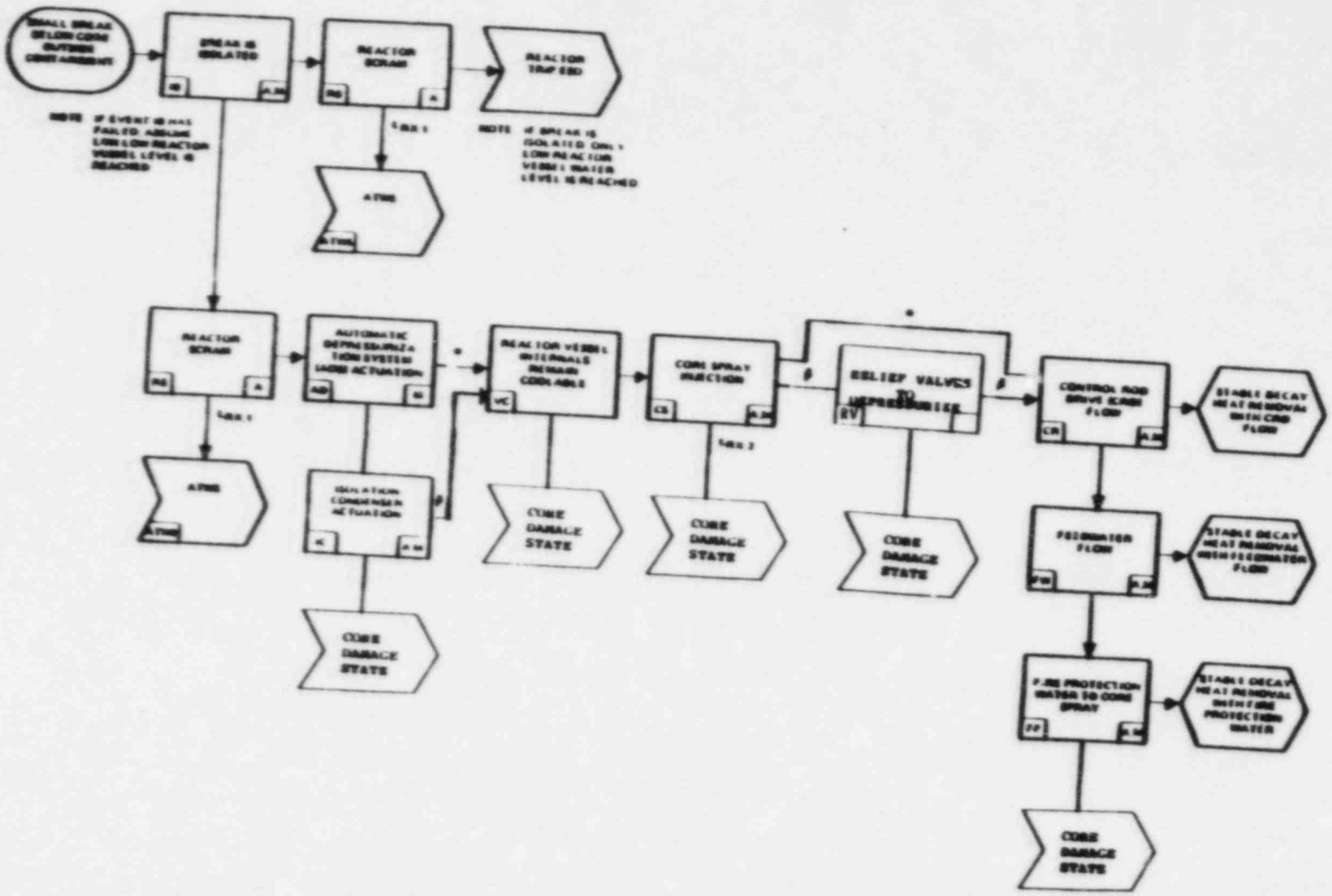

FIGURE 2. ESD FOR SMALL BREAK BELOW CORE OUTSIDE CONTAINMENT

RELEASE CATEGORY EVENT TREE PLOT DATE 83/11/17.

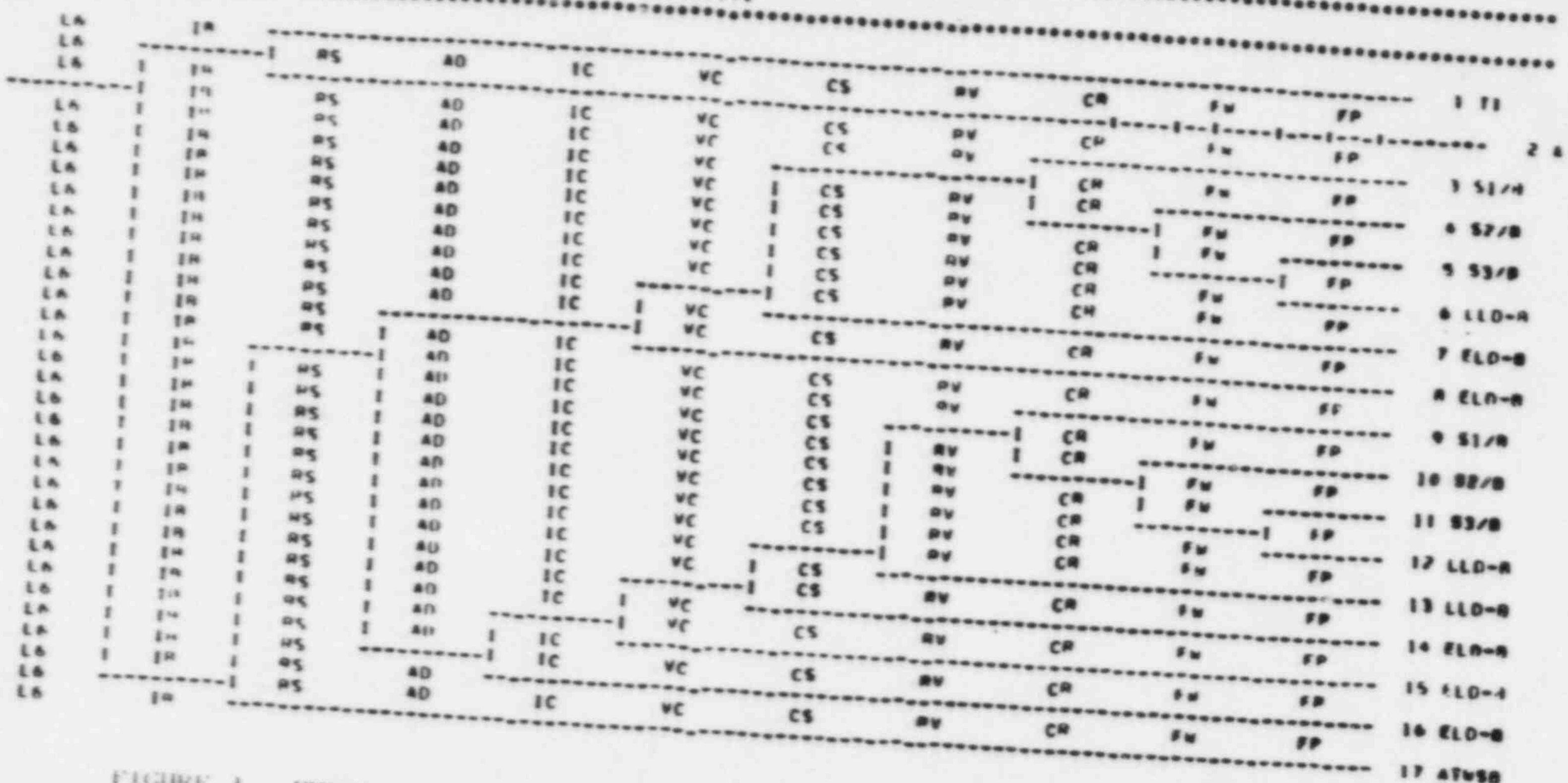

FIGURE 3. EVENT TREE FOR SMALL BREAK BELOW CORE OUTSIDE CONTAINMENT

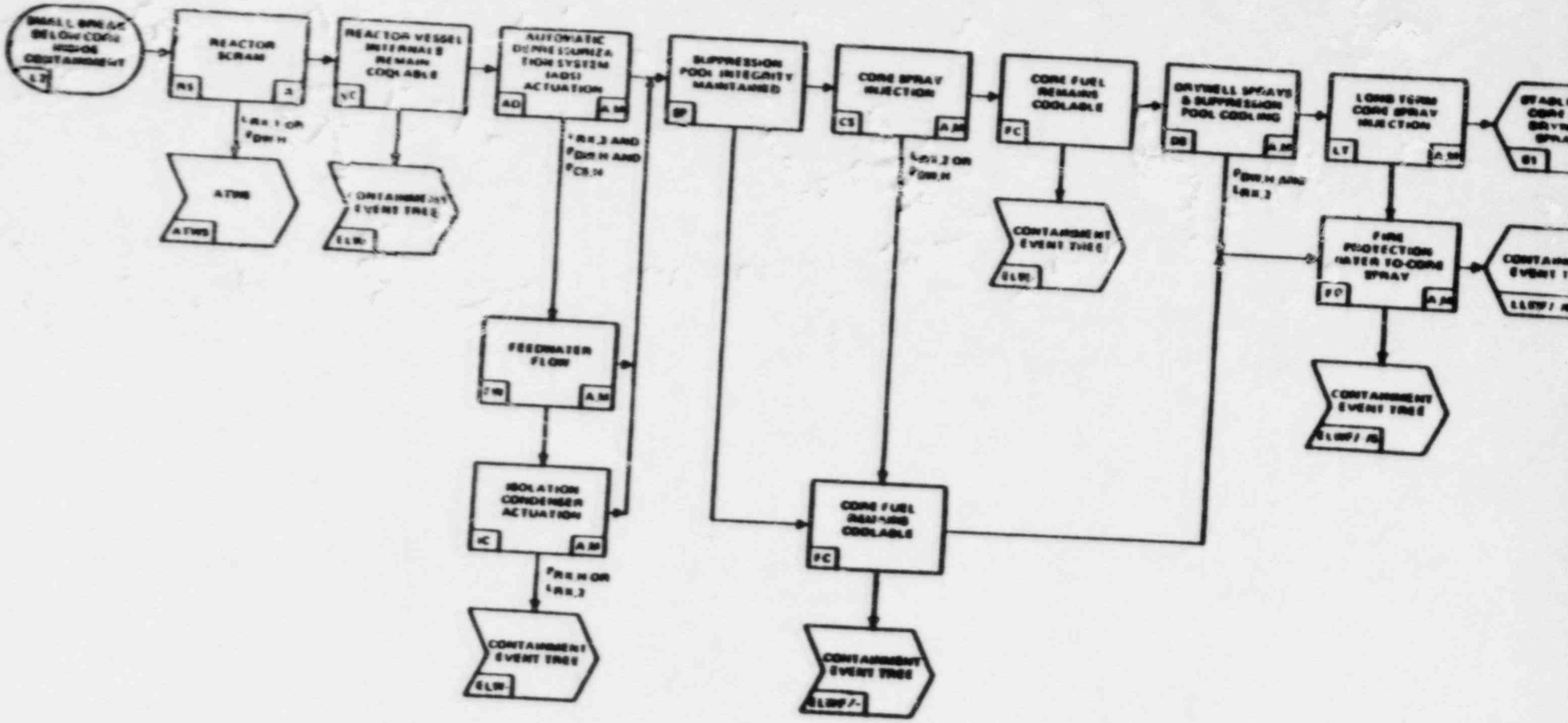

FIGURE 4. ESD FOR SMALL BREAK BELOW CORE INSIDE CONTAINMENT

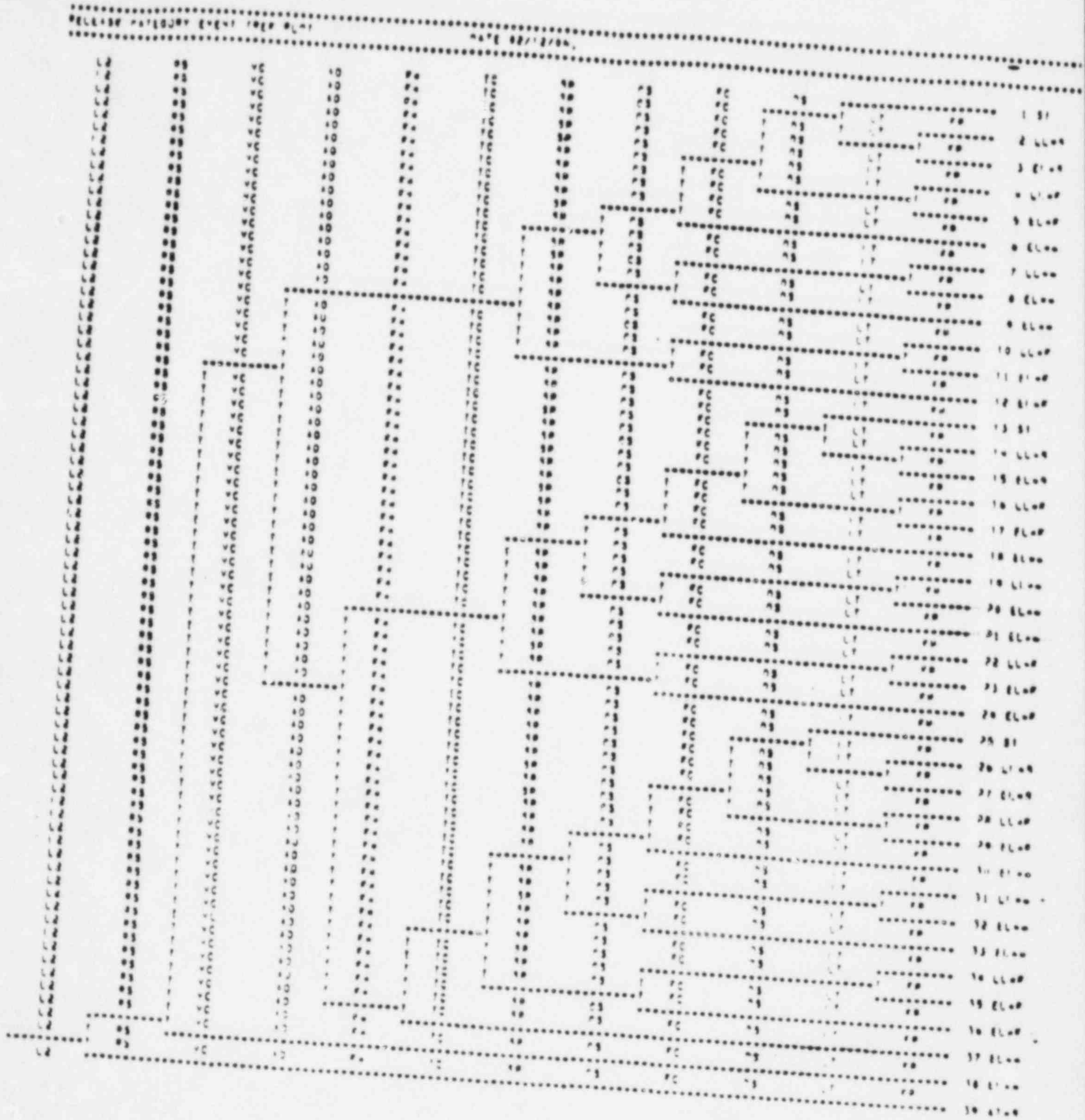

FIGURE 5. EVENT TREE FOR SMALL BREAK BELOW CORE INSIDE CONTAINMENT