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FYR 85-107

October 15, 1985

Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

Attention: Mr. Hugh L. Thompson, Jr.
Director, Division of Licensing

References:
(a) License No. DPR-3 (Docket No. 50-29)
(b) USNRC Letter to All Power Reactor Licensees, dated April 16, 1985 (Generic Letter 85-06)
(c) 10CFR, Part 50.62, "Reduction of Risk From Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants," Final Rule 49FR26036
(d) Yankee Nuclear Power Station Probabilistic Safety Study
(e) USNRC Letter to YAEC, dated August 16, 1982
(f) NUREG-0825, June 1983
(g) AEOD/P405, "Final Trends and Patterns Report on Feedwater Transients at Westinghouse Plants"

Subject: Request for Exemption from the ATWS Rule

Dear Sir:

We have reviewed Generic Letter 85-06, Reference (b), on the implementation of the ATWS rule and related guidance provided in the Federal Register, Reference (c), for the Yankee Nuclear Power Station (YNPS). The Federal Register states that exemptions to the ATWS rule may be granted to plants licensed to operate prior to August 1969 if it can be demonstrated that their risk from ATWS is sufficiently low due to such factors as power level, unique design features, remaining plant lifetime and remote siting. After careful consideration of the rule, we conclude that the risk of an ATWS at YNPS is sufficiently low and request an exemption from the rule. Our request is based on the small size and remote siting of YNPS, unique features associated with its Reactor Trip System, the experience and training of the operators and the excellent operating record over the past 25 years.

YNPS is a Westinghouse, four-loop, Pressurized Water Reactor (PWR) and is relatively small by today's standards. The electrical output is 185 MWe versus 1,200 MWe; the core is 7.5 feet high versus 12 feet; the core diameter is 6.3 feet versus 11 feet, there are 76 fuel assemblies versus 193 assemblies; and the core thermal output is 600 MW versus 3,400 MW.

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The plant is located in a river valley on a 2,000 acre site in the rural northwestern corner of Massachusetts. The area is sparsely populated with 60 people within a 1-mile radius of the plant, 1,600 within a 5-mile radius and 24,000 within a 10-mile radius. The low population zone for the plant extends 2 miles upstream and 6 miles downstream from the plant and has an estimated population of 260 persons. The population density within 5 miles is 20 persons per square mile. The population numbers have remained stable since the plant was built and are expected to remain stable in the future.

YNPS has several unique design features including one which makes the Reactor Trip System significantly more reliable than most modern designs. The same power source (Circuit #12 of 125 V dc Bus #2) that supplies motive power to open the reactor trip breakers (energize the shunt trip coils) also supplies holding power to the rod holding coils. Since there are no circuit interruptors (circuit breakers or fuses) separating these devices, in the unlikely event of a loss of dc tripping power to the scram breakers, all rods insert due to loss of rod holding power. A highly reliable Reactor Trip System is clearly the best protection against ATWS.

There has never been a failure of a reactor trip breaker to open at YNPS, either in testing or actual demand, in more than 25 years of operation. Furthermore, it is operating policy at YNPS, by procedure, to manually actuate the reactor and turbine trip buttons on <u>every</u> unanticipated trip and to immediately reaffirm that these trips have occurred. Restart of the main feedwater pumps (or initiation of emergency feedwater, if required) is also a manual action which the operating staff is instructed to perform on <u>every</u> trip. In view of the routine nature of these actions and a highly experienced staff, it is very unlikely that the operators would fail to initiate/reaffirm trip or fail to provide feedwater at YNPS.

In the area of mitigation of an ATWS event, YNPS, like most Westinghouse reactors, has an automatic rod control feature which drives the selected control group in on high Main Coolant System temperature. YNPS has the additional unique capability of simultaneously driving all 24 control rods in; this feature is manually actuated at the main control board.

YNPS was licensed for operation on July 19, 1960, and has recently completed 25 years of safe, reliable operation with a lifetime capacity factor exceeding 70%. The plant has set its all-time record of over 330 days of continuous operation during its 25th year of operation, which attests to its continuing fine performance. The frequency of plant trips/transients for YNPS is below the industry average. A recent NRC study [Reference (g)] identified Yankee as a <u>low frequency</u> "outlier" with regard to feedwater transients. In fact, YNPS has never challenged the Emergency Feedwater System.

In the review of our request, it may be helpful to consider two previous NRC reviews of the Emergency Feedwater System of YNPS. The first was regarding Item II.E.1.2 of NUREG-0737 [see Reference (e)]; the second was related to SEP Topic VII-3 [see Section 4.19.1 of Reference (f)]. Both of these studies concluded that automatic initiation of emergency feedwater was unnecessary at YNPS.

The YNPS Probabilistic Safety Study [Reference (d)], an important part of our overall risk review, indicates that the risk imposed by YNPS is small and ATWS is not a major risk contributor. The total annual core melt frequency was conservatively calculated to be less than 2×10^{-5} which is well below the NRC proposed safety goal of 10^{-4}. The calculated frequency of ATWS induced core melt is about 10^{-6} per year.

The details of this risk summary, as well as additional information relevant to the low risk to YNPS from the ATWS event, have been provided as an attachment to this letter.

Based upon the information submitted herein, Yankee has concluded that the requirements of 10CFR50.62 are neither needed nor justified at YNPS. Therefore, Yankee respectfully requests exemption from the requirements of 10CFR50.62.

FEE

An application fee of $150.00 is enclosed in accordance with 10CFR170.21.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

L H Heider

L. H. Heider
Vice President/Manager of Operations

LHH/glw

ATWS RISK SUMMARY

Introduction

Yankee Nuclear Power Station (YNPS), owned and operated by Yankee Atomic Electric Company (YAEC), is a relatively small pressurized water reactor located in rural Northwestern Massachusetts. First licensed for operation by the US Atomic Energy Commission in 1960, the plant has recently completed 25 years of safe, reliable electric power production with a lifetime capacity factor of 73%.

With the prime goal being continued outstanding records for plant safety and reliability, YAEC, in 1981, initiated a probabilistic study of risks associated with the operation of the plant. The Yankee Nuclear Power Station Probabilistic Safety Study (PSS), Reference 1, was conducted to provide additional insights into plant design and operation as well as to incorporate the latest analytical tools into the decision making process. A spectrum of internal events ranging from plant trip to large break LOCA was examined. Failure to scram and failure of chemical shutdown were included in the PSS as appropriate.

Probabilistic Safety Study

The results of the PSS demonstrate that operation of Yankee Nuclear Power Station poses a very small risk to public health and safety both according to the context of NRC proposed safety goals, and comparisons with other probabilistic safety studies performed for other nuclear power plants. Using a model based on certain conservative assumptions (e.g., Appendix K based success criteria), the calculated mean core melt frequency for YNPS is less than 2×10^{-5} per year and the corresponding individual fatality risk is about a factor of 2,600 lower than NRC safety goals (see Figures 1-3).

The low core melt frequency results from the conservative and diverse design of the Nuclear Steam Supply System and associated support systems. In general, YNPS has more systems available - and they are simpler in design - than contemporary plants. Additionally, the frequency of off-normal events has been shown to be small during its 25 years of operation.

An example of the redundancy and diversity of design is the number of ways to supply feedwater. There are ten pumping trains and eight flow paths available to supply feedwater to the four steam generators. An example of the conservative design of the plant is that each of these systems is manually initiated. Automatic initiation is not required because of the larger than typical inventory of the steam generators and the low operating temperature of the Main Coolant System. An example of the low frequency of off-normal events is that the Emergency Feedwater System has never been required to operate in response to an off-normal event in 25 years of operation.

Coupling low core melt frequency with small core size, remote plant location, and an effective vapor container, the public risk profiles show exceedingly small overall risks of either acute or latent fatalities. (The plant is about a factor of 5 smaller than contemporary plants and only 60 people live within 1 mile of the plant).

The YNPS PSS and the tools developed in support of it provides YAEC with an ongoing resource for performing personnel training, evaluating plant modifications internally and in response to NRC inquiry, evaluating Technical Specification changes, and enhancing operational and emergency procedures. YAEC is continuing to evaluate the current study findings and is integrating these techniques into the overall decision making process.

Since the PSS was completed in 1982, several plant improvements have been installed (or are being installed) as a result of risk studies and the completion of the Systematic Evaluation Program. Among these improvements are Reactor Protection System upgrades, Containment Isolation System improvements and installation of a Safe Shutdown System. In addition, there have been improvements in PRA methods, especially in the source term area, which would result in an even more favorable calculated risk result today.

Several plant design and operational features which contribute to low risk are:

Transient events have a low frequency of occurrence (e.g., only three loss of main feedwater events have occurred in 25 years; in each event main feedwater was recovered prior to the initiation of emergency feedwater).

Secondary cooling means (i.e., feedwater) are more substantial than at most modern plants (ten pumping trains and eight flow paths are available to supply feedwater to the steam generators).

Main coolant pumps are of a canned design, and a LOCA induced by coolant pump seal failures is not possible. Additionally, makeup requirements to the Main Coolant System are minimal.

Front-line systems rely only minimally on support systems (e.g., complete losses of service water, component cooling water, or control air are negligible contributors to core melt frequency).

Three totally separate and self-contained air cooled diesel generators exist. Their performance has proven to be substantially better than industry average.

Even for the station blackout event the plant can be safely brought to hot shutdown using the steam-driven emergency feedwater pump or the new Safe Shutdown System. This pump or the new system do not require either normal or emergency station dc or ac power.

Significant margins exist to design limits during normal operations. Compared to more contemporary designs, Main Coolant System and Secondary System operating pressures and temperatures are lower, and the total secondary coolant inventory is larger compared to plant thermal output. These favorable features reduce challenges requiring safety and relief valve operation, thereby reducing the likelihood of transient induced LOCAs. In fact, there has never been a challenge of either the primary or secondary safety valves in the 25-year operating history of YNPS. The inherent thermal margin provides more opportunity for successful operator diagnosis and intervention.

For these same reasons, loss-of-coolant accidents (LOCAs) are the dominant contributors to core melt frequency using either conservative or best-estimate assumptions. Even from a probabilistic perspective, core melt resulting from sequences involving an extended loss of feedwater - main feedwater, emergency feedwater and other backups - is essentially an incredible event. This results from the diversity and redundancy of the secondary plant design and the time available to initiate feedwater systems. ATWS (Anticipated Transients Without Scram) sequences contribute less than 10% to the total core melt frequency using either conservative or best-estimate assumptions. This is due to the low frequency of transients, the reliability of the reactor trip systems and the backup capability of the Charging System. Use of the Charging System for chemical shutdown is well proceduralized.

Anticipated Transients Without Scram

All of the factors discussed above, and a few others, combine to yield a low risk from all events, including ATWS. ATWS is not a significant contributor to plant risk for three reasons; the most important of these, which is also clearly the key to ATWS prevention, is the Reactor Trip System (RTS). The unique RTS design at the YNPS has proven to be highly reliable. The probability of scram failure on demand is about 10^{-5} per demand. This trip system reliability, along with the backup shutdown capabilities of chemical injection and a low frequency of plant transients results in a conservatively calculated annual core melt frequency due to ATWS of about 10^{-6} per year. This frequency takes no credit for operator actions o drive all rods in nor for proceduralized actions to de-energize the rod gripper coils from the switchgear room.

Yankee's unique trip system design is shown in Figure 4. The most important element of this design is that one DC power circuit supplies both the rod gripper coils and the shunt trip devices which open the reactor trip breakers. Therefore, loss of breaker tripping power (at either the bus or circuit level) will result in a scram since the rods will fall by gravity as the gripper coils de-energize. With this "fail-safe" trip circuit design, there is no need to rely on undervoltage devices which have recently been the subject of much industry controversy. Since shunt trip devices strike the breaker trip mechanism with significantly more force than undervoltage devices, YNPS is significantly less likely to experience a reactor trip breaker failure to open than is suggested by past industry experience and generic trip breaker failure data.

In addition to its "fail-safe" design, the circuit includes a supervisory light on the main control board for each trip breaker which continuously monitors actual current flow through the shunt trip coil and all trip circuit wiring up to each of the three manual trip push buttons.

Figure 4 also shows a simplified diagram of the control rod drive system's "all rods in" feature which is manually actuated from the control room.

General Low-Risk Design

The basic plant design allows for relatively small, simple plant equipment (both normal and emergency) which essentially eliminates the need for complex, interdependent support systems and complicated automatic initiation/control features. Thus, there is no need at YNPS for the many complicated automatic systems which are a familiar part of more recent plant designs. The manual operator control over relatively simple systems, during both normal and off-normal operation, and the inherent thermal margins in the plant are a significant factor in its excellent operating record.

Operating Philosophy and History

With more than 25 years of operating experience, YNPS is the nations oldest operating nuclear power station. The operating staff at YNPS is well trained, highly experienced and very familiar with plant equipment and its operation. Their excellent capabilities are due largely to the manual nature of YNPS operation. In the event of an off-normal condition, the actions required of the operating staff would be the same as, or similar to actions they take normally and are very familiar with. For example, the Emergency Shutdown From Power operating procedure requires that the operator manually actuate the reactor and turbine trip push-buttons on every unanticipated plant trip and reaffirm that these trips have occurred. Thus, in the unlikely event that automatic plant trip failed, for whatever reason, the operator's initial action, manual trip, is exactly the same action he takes on any trip. Although not "routine", the manual trip action is certainly familiar; and the probability of the operator to fail to manually initiate trip at YNPS is extremely small.

Supplying feedwater following plant trip is also a manual action with which the operating staff is quite familiar. On any plant trip, the three main feedwater pumps are tripped by auxiliary contacts in the reactor trip breakers. (This automatic main feedwater trip will not occur if the reactor trip breakers fail to open.) Following every trip, the operator manually restarts one main feedwater pump. If main feedwater could not be restarted, the operator would manually start emergency feedwater. Again, providing feedwater is a manual action which the operators perform on every trip; it is very unlikely that the operators would fail to do so.

REFERENCE

1. Yankee Nuclear Power Station Probabilistic Safety Study

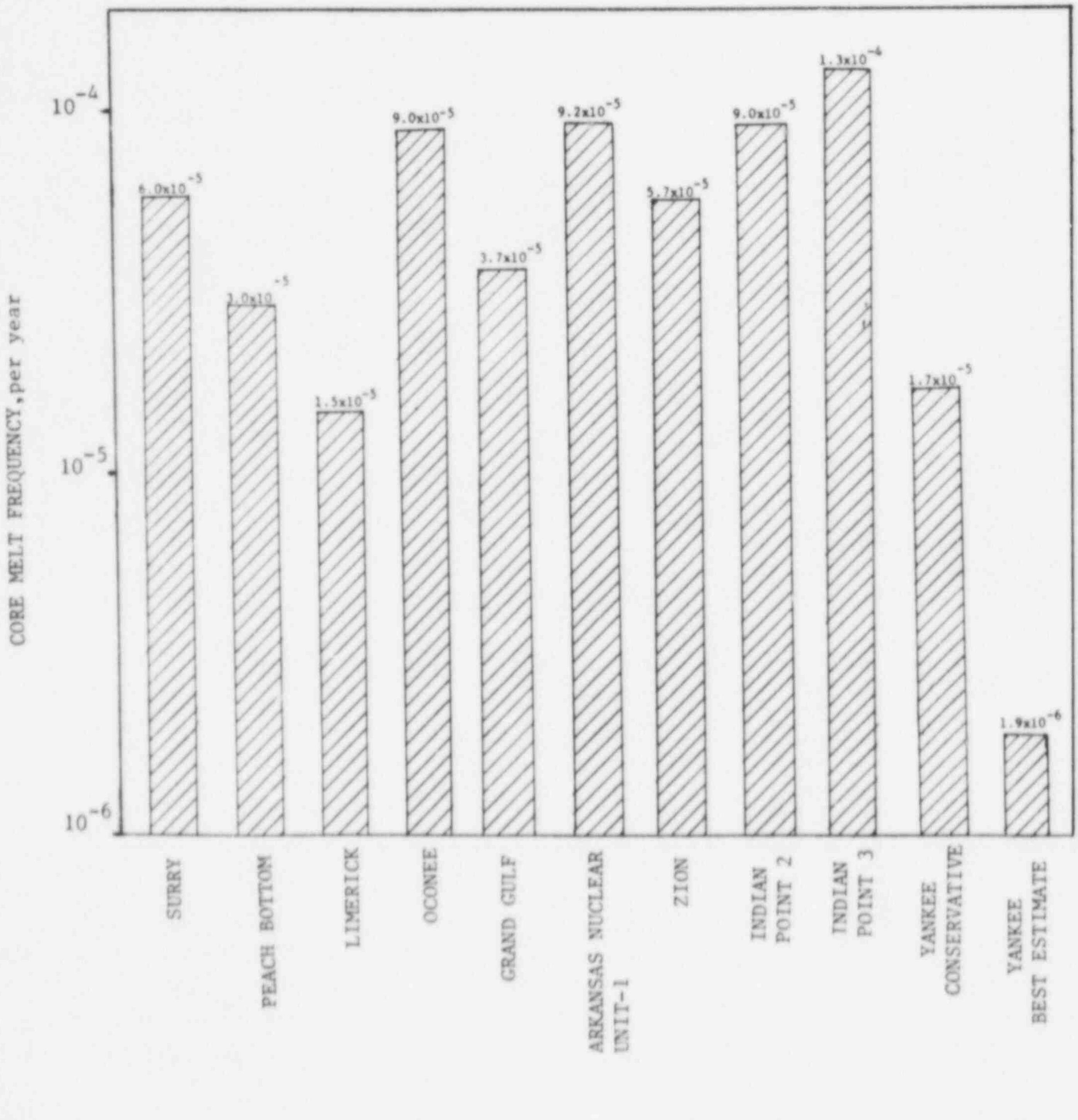


FIGURE 1

CORE MELT FREQUENCY COMPARISONS

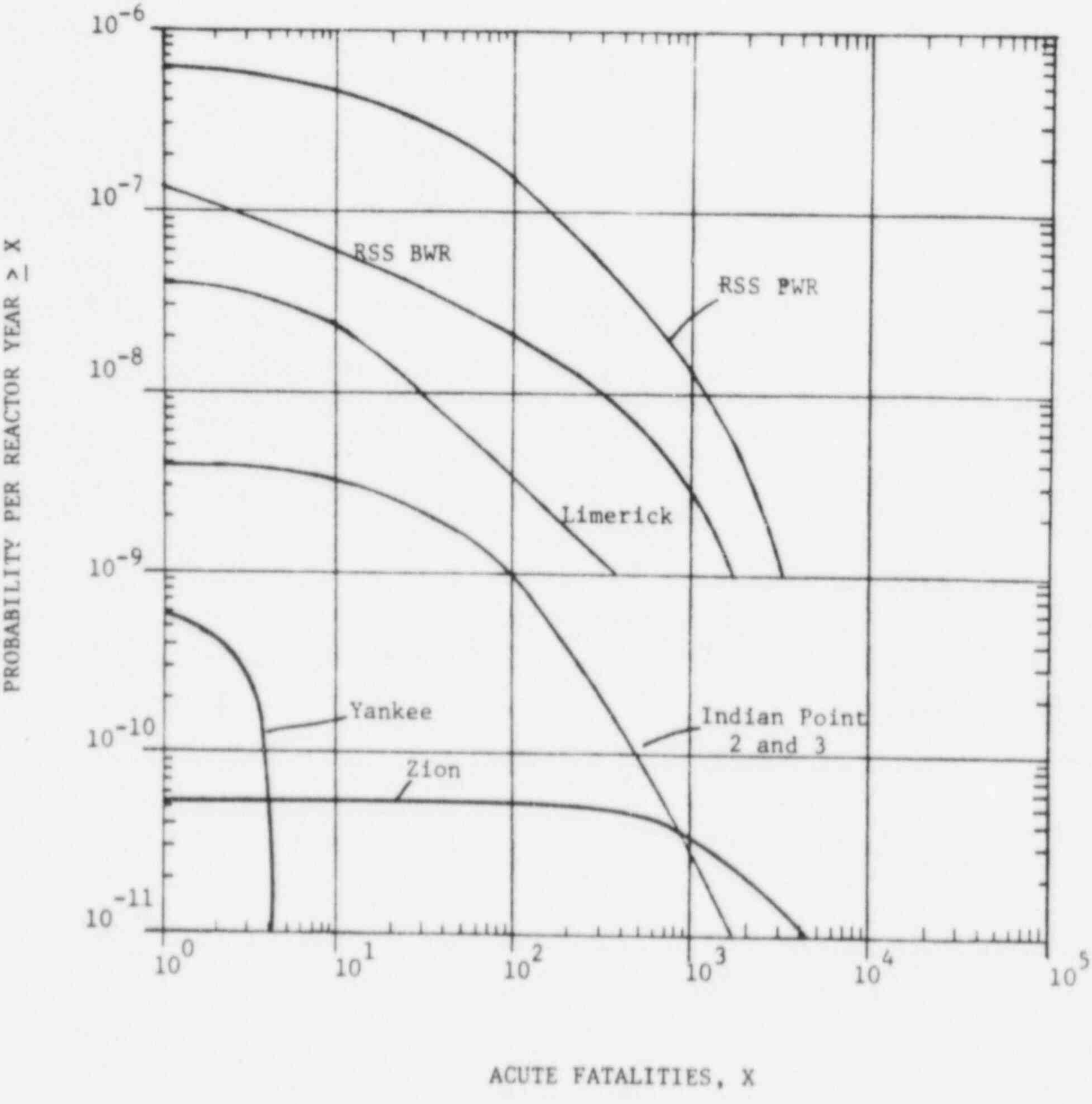


FIGURE 2 **Comparisou of Acute Fatalities**

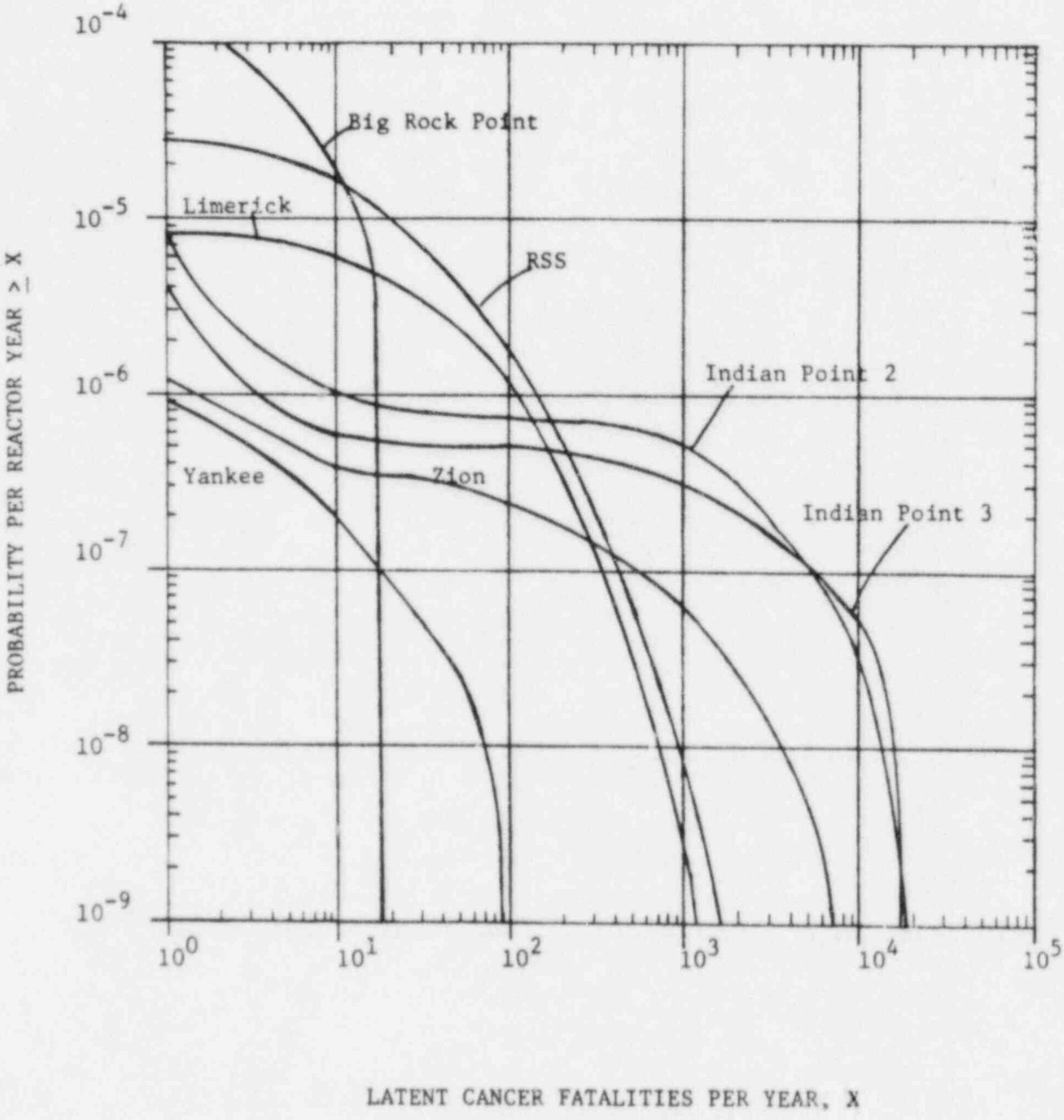
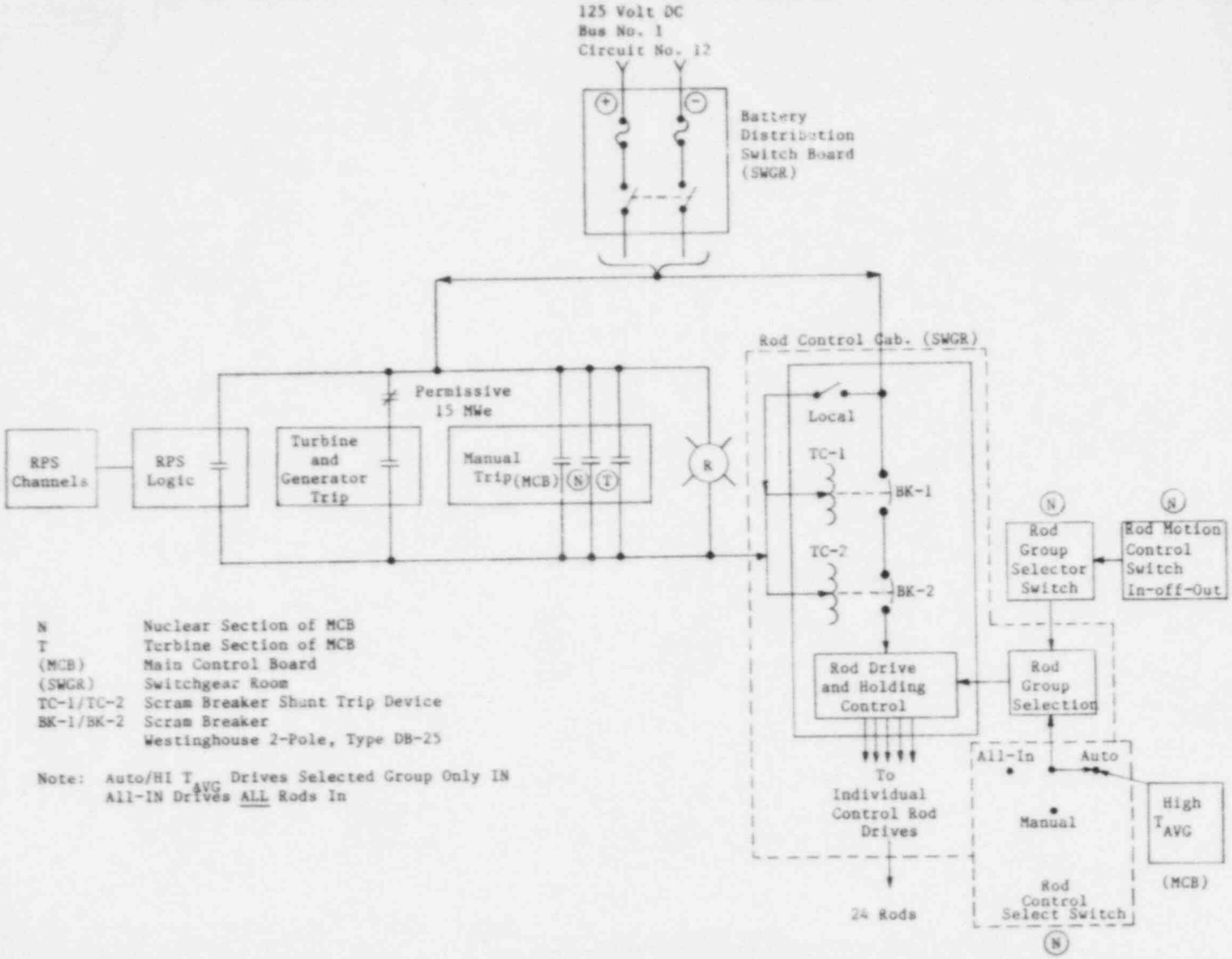


FIGURE 3 **Comparison of Latent Cancer Fatalities**



N	Nuclear Section of MCB
T	Turbine Section of MCB
(MCB)	Main Control Board
(SWGR)	Switchgear Room
TC-1/TC-2	Scram Breaker Shunt Trip Device
BK-1/BK-2	Scram Breaker Westinghouse 2-Pole, Type DB-25

Note: Auto/HI T_{AVG} Drives Selected Group Only IN
All-IN Drives ALL Rods In

FIGURE 4