NATHAN M. NEWMARK
CONSULTING ENGINEERING SERVICES

1211 CIVIL ENGINEERING BUILDING
URBANA, ILLINOIS 61801

2 August 1979

Addressee

Mr. H. A. Levin
Mr. C. Hofmayer
Mr. F. J. Tokarz
Dr. J. D. Stevenson
Dr. R. P. Kennedy
Mr. R. Murray
Dr. N. M. Newmark

Re: Contract NRC-03-78-150
SEP Seismic Review Evaluation
Dresden 2

Gentlemen:

As a result of the conversation between NRC personnel and ourselves today, we request that the following Section 4 be added to the end of the Chapter 1 section entitled "Concluding Evaluation and Assessment". Other minor changes to the earlier material submitted under date 7/20/79 also are included.

We urge each SSRT member to examine all conclusions carefully to be sure they reflect the views of all of us.

Also we ask that Bob Murray transmit the revised material to the editor for inclusion on the computer version.

Sincerely,

Bill

W. J. Hall

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Enclosure

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Hydraulic tubing for control rod drives and their support

Motor-operated valves mounted on piping less than 4 in. in diameter

Battery racks

Cable trays and supports

Electrical equipment cabinets and equipment mounted therein (including for example motor control centers and switch gear)

Pipe supports designed using lateral deflection and force evaluation curves

Reactor vessel supports

Concluding Evaluation and Assessment -- Based on the combined experience and judgment of the members of the SSRT, the reviews and spot checks of the original design analyses, and recent revisions and amendments to these analyses, and on comparisons with similar items of equipment and components in other more recently designed reactors, it is our conclusion that:

1) The structures and structural elements of the Dresden facility are adequate to resist an earthquake with an SSE value of acceleration of 0.2 g, with one possible exception as noted earlier.

2) The piping in the facility is adequate to resist an earthquake with an SSE value of about 0.15 g without being strained beyond elastic limits; and is adequate to resist 0.2 g with acceptable inelastic deformation.

However, we have not reviewed in detail the as-built piping supports to determine if they are fully in accord with the design criteria. We recommend that the as-built spacing of pipe support design using lateral deflection and force evaluation curves be checked to ensure that the spacing

is consistent with attaining a piping frequency greater than two times the building frequency as stated in the design criteria.

3) Based upon the examination of selected equipment that in our judgment represents a lower bound with respect to seismic fragility, we feel that the equipment in the facility is adequate to resist an earthquake with an SSE value of 0.20 g, and subject to satisfying several points which are discussed below, should remain functional. This conclusion is based upon consideration of modern criteria involving floor response spectra, especially at upper levels of the structures where amplified motions might be expected, and with the realization that the uncertainty bound for the seismic resistance of equipment is broad. It is felt that the margins for damage of equipment are probably less than specified by current criteria, but it is our assessment that the possible damage should not impair functional capability. We recognize that less rigorous design criteria existed when the equipment was manufactured, and there was also less attention paid in the design to support of equipment.

The above conclusions are predicated on the following additional points:

i) That all safety-related electrical equipment in the plant is checked to ensure that adequate positive anchorage exists.

ii) That remaining items identified previously are evaluated and upgraded if required, including the specified design modifications documented in Ref. 5.24.

iii) That a general reconnaissance of the plant be made to identify and upgrade if necessary any overhead or suspended items which could be

dislodged or fall during an earthquake and impair capability of the plant to shut down safely.

4) With regard to seismic criteria the functional reliability of electrical equipment and, to a lesser degree, that of mechanical equipment are among the most difficult items to evaluate. In recent years shake table tests of generic and/or specific prototype equipment systems are conducted to confirm their reliability, or alternatively, analyses are made where modeling is possible and rational.

Because equipment is expected to function in an active manner during its lifetime (as contrasted to the passive function of structural systems or elements) it is to be expected that failures, especially in some classes of equipment, will occur from time to time under normal operation. Realization of this situation is one of the reasons that redundancy of safety systems is normally required, thereby reducing reliance upon a single system in the event of a seismic disturbance that might by chance render a piece of equipment inoperable, especially if it has been functioning for an extended period of time.

With appreciation of the state-of-the-art of equipment qualification at the time of the Dresden 2 design and as carried out and reported in generic testing (See Chapter 4), and on the basis of years of experience by members of the SSRT group with respect to functioning of equipment, not only in earthquakes throughout the world but also under military requirements, it is our opinion, in the case of Dresden 2, that there is strong reason to believe that the equipment will remain functional under the design hazard. This conclusion is predicated upon the considerations that there are degrees of

redundancy in safety systems to avoid dependence on any one system, and on the premise that a comprehensive equipment maintenance program is carried out.