UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO PRESSURIZER HEATER TRANSFORMER BARRIER DESIGN TO FACILITY OPERATING LICENSE NO. NPF-16 FLORIDA POWER AND LIGHT COMPANY ET AL. ST. LUCIE PLANT, UNIT NO. 2 DOCKET NO. 50-389

## BACKGROUND

During a Power Systems Branch site visit in 1982, the staff identified two transformers in the cable spreading area as "high energy equipment" that could produce missiles should failure occur. The licensee committed to install a suitable barrier around the transformers to preclude potential damage to the surrounding equipment from missiles should the transformers fail. On February 27, 1984 the licensee submitted a letter report, Reference 1, outlining the action taken to contain missiles in the transformer area. This Safety Evaluation (SE) reports the staff's evaluation based on the February 27, 1984 submittal and subsequent discussions with the licensee's engineering personnel.

## DISCUSSION

The two transformers that supply the electrical power to the pressurizer heaters are located in the cable spreading area in the Auxiliary Building at elevation 43.0 feet. Should these transformers fail, missiles could be generated that could damage the cables and equipment in the surrounding areas. To prevent these missiles from impacting vital equipment, the licensee has proposed to construct a missile barrier around each of the transformers. The barrier is 7'-6" long by 6'-2" deep and 8'-3" high and encases each transformer individually. The barrier is constructed of a frame covered with grating. The grating stops the missile from escaping the barrier and the frame supports the grating.

Details of the barrier are shown in Figure 1. The frame of the barrier is constructed of square tube columns and square tube horizontal members. This frame is anchored to the concrete floor by four expansion anchor bolts at two corners and five expansion anchor bolts at the other two corners. The grating is composed of bars spaced at 1-3/16 inches on center, sandwiched between the supporting frame and horizontal square tubing bolted to the frame. Where small missiles could penetrate the spacing between the grating bars, 3/4 inch flat steel plates were welded to the transformer side of the grating to stop the potential missile.

The 12 potential missiles that could escape from a ruptured transformer case range from a 0.2 square inch plug (0.34 lbs) that could attain a velocity of 70 fps to a relief value (35 lbs.) with velocity of 43 fps and impact an area of 50 square inches. The missile with the most energy was the manhole cover (17 lbs) with a velocity of 135 fps and an impact area of 240 square inches.

The barrier was designed for loads that result from the impact of a missile in combination with the barrier dead weight. Only one missile at a time was considered to impact the barrier. The Ballistic Research Laboratory (BRL) formula was used to determine the required barrier thickness to prevent perforation.

Using a maximum ductility ratio of 10, the loading on the tubular frame from the missile impact was determined by calculating the grating reactions by a standard plastic analysis technique as outlined in a textbook by B.G. Neal (Ref. 2). The procedure is iterative, requires a starting assumption for the ductility ratio, and is based on the plastic bending of a uniform simple supported cross section beam. The computations produce a required ductility ratio that is then compared to the assumed ductility ratio. If the ratios are different, the assumed ductility ratio is then modified and the calculations are repeated. This procedure is continued until the required ductility ratio is the same as the assumed ductility ratio. The procedure is further discussed in Reference 2.

The missile barrier was also evaluated for seismic loads. The seismic loads were combined with the barrier dead load. The natural frequency of the barrier was calculated and the corresponding acceleration was obtained from the Elevation 43 feet Auxiliary Building floor response spectra for 2% damping: this value was 0.7g for horizontal acceleration. A conservative value of 1.0g was used in the analysis. The three directions of motion were combined using the square root of the sum of the square (SRSS) method as required by the FSAR.

EVALUATION AND CONCLUSIONS

The staff has reviewed the February 27, 1984, licensee submittal and subsequent information provided by the licensee. Methods used to determine the required missile barrier thickness and to include effects of seismic loads are acceptable. Also, the steel plates welded to the inside face of the grating to prevent exit of potential small missiles were properly analyzed and designed.

The design is adequate to prevent the potential missiles described from exiting the barrier. Therefore the design, as presented, is acceptable.

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REFERENCES


1. Letter FP&L to Darrell G. Eisenhut dated February 27, 1984 with attachments.

2. B. G. Neal, "The Plastic Methods of Structural Analysis", Chapman and Hall Ltd., pages 172 - 175.

3. Letter FP&L to James R. Miller dated June 27, 1984 with attachments.

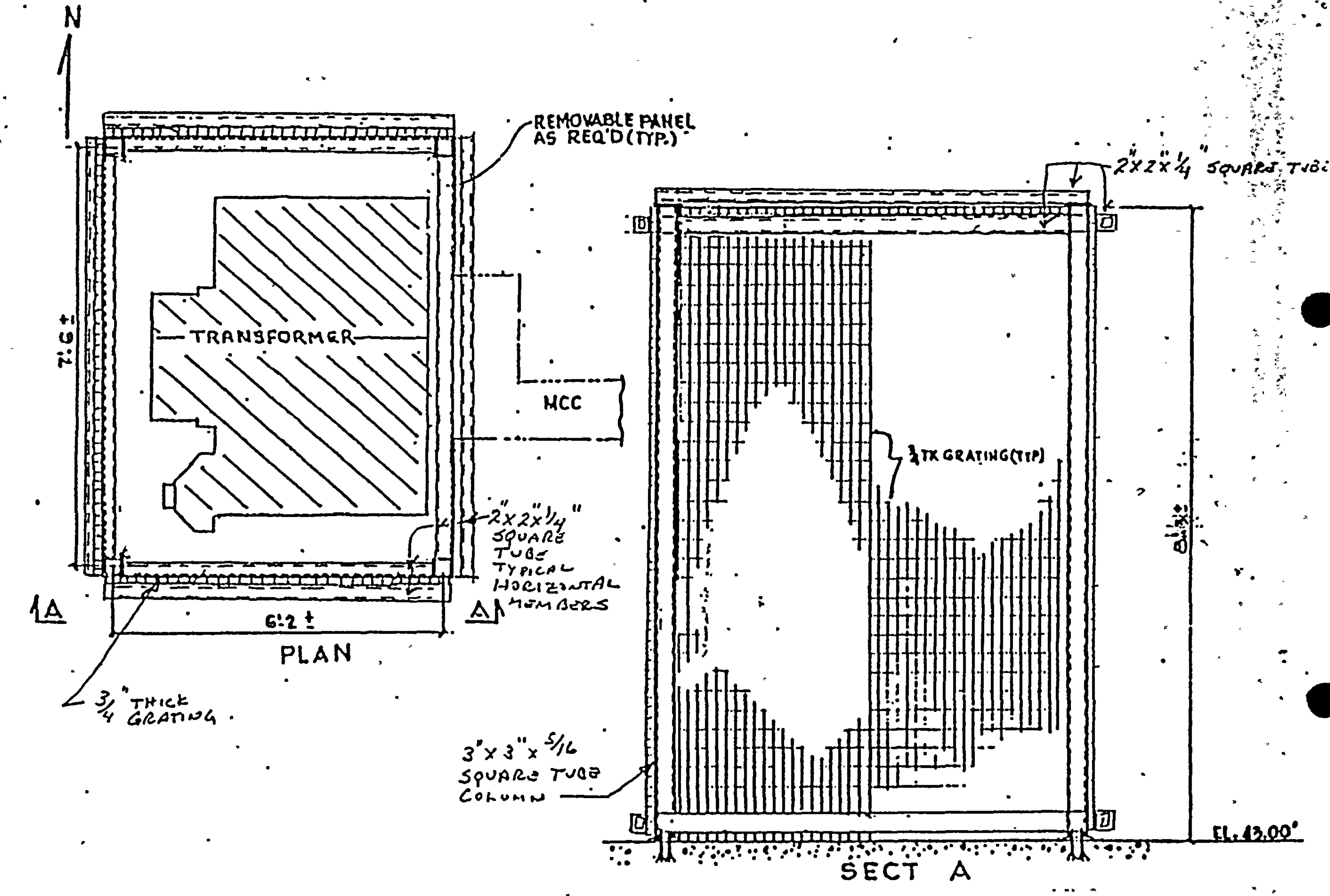
N
REMOVABLE PANEL AS REQ'D (TYP.)
TRANSFORMER
MCC
2"x2"x1/4" SQUARE TUBE TYPICAL HORIZONTAL MEMBERS
A
A
6'-2 ±
PLAN
3/4" THICK GRATING
2"x2"x1/4" SQUARE
3/4" TK GRATING (TYP)
3"x3"x5/16 SQUARE TUBE COLUMN
EL. 43.00'
SECT A

FIGURE 1

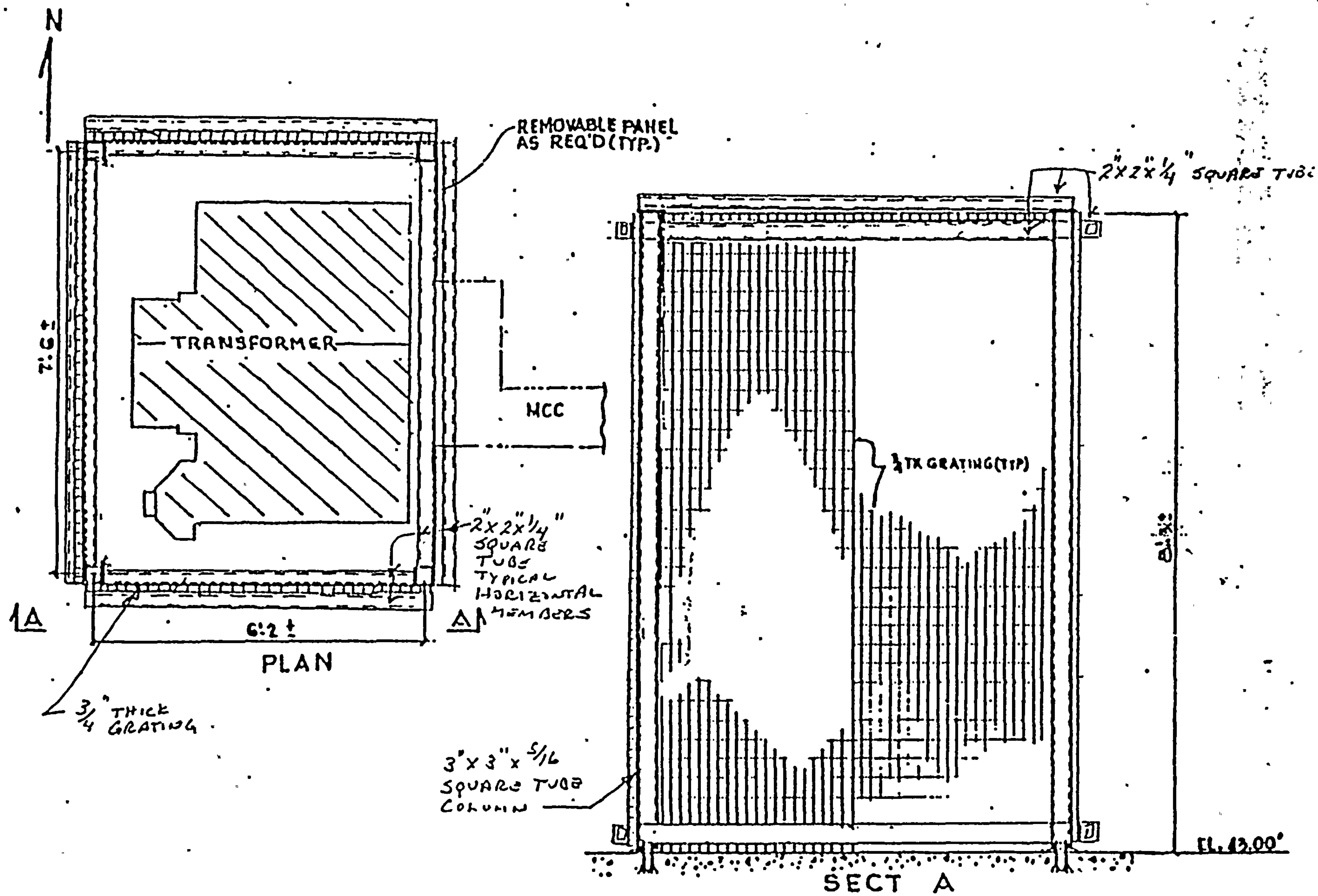
N
REMOVABLE PANEL AS REQ'D (TYP.)
TRANSFORMER
MCC
2"x2"x1/4" SQUARE TUBE TYPICAL HORIZONTAL MEMBERS
3/4" THICK GRATING
6'-2 ±
A
A
PLAN
2"x2"x1/4" SQUARE TUBE
3/4 TK GRATING (TYP)
3"x3"x5/16 SQUARE TUBE COLUMN
SECT A

FIGURE 1