

START NEW PAGE

PROPOSED CHANGE NO. 4

FOR THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR

RE\ LICENSE DR-15 DOCKET 50-231

START NEW PAGE

PROPOSED CHANGE NO. 4 FOR THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR

## I. INTRODUCTION

UNDER THE AUTHORITY OF LICENSE DR-15, GENERAL ELECTRIC OPERATES THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR AT A SITE NEAR STRICKLER, ARKANSAS.

A REVISION OF THE CURRENT TECHNICAL SPECIFICATIONS IS DESIRED AS DESCRIBED HEREIN. THE APPLICABLE REVISED PAGES OF THE TECHNICAL SPECIFICATIONS ARE ALSO INCLUDED AS ATTACHMENT A.

## II. PROPOSED CHANGES

PURSUANT TO THE PROVISIONS OF 10 CFR 50.59, GENERAL ELECTRIC REQUESTS THAT THE SEFOR TECHNICAL SPECIFICATIONS BE CHANGED BY SUBSTITUTING PAGES 3.10-1, 3.10-2, AND 3.10-3 IN ATTACHMENT A OF THIS DOCUMENT FOR CORRESPONDING PAGES OF THE CURRENT TECHNICAL SPECIFICATIONS AND BY ADDING PAGES 3.13-1 THROUGH 3.13.3 IN ATTACHMENT A OF THIS DOCUMENT TO THE CURRENT TECHNICAL SPECIFICATIONS. THE PROPOSED CHANGES IN SECTION 3.10 ARE INDICATED BY MARKS IN THE MARGIN. THESE MARKS WERE OMITTED IN SECTION

9705130142 970505  
PDR FOIA  
VARADY97-34 PDR

9705130142

### III. PURPOSE OF THE PROPOSED CHANGE

SPECIFICATION 3.10-E OF THE PRESENT SEFOR TECHNICAL SPECIFICATIONS REQUIRES THAT CERTAIN ADDITIONAL SPECIFICATIONS BE APPROVED AND INCORPORATED INTO THE TECHNICAL SPECIFICATIONS PRIOR TO INITIAL OPERATION AT 20 MWT. THESE SPECIFICATIONS ARE SUBMITTED HERewith, BASED ON EXPERIENCE GAINED IN OPERATING SEFOR UP TO AND INCLUDING THE 10 MWT POWER LEVEL.

### IV. DISCUSSION

A. LIMITS FOR UNEXPLAINED REACTOR BEHAVIOR ARE BASED ON THE ABILITY TO DETECT CHANGES IN PARAMETERS AND ON THE VARIATIONS WHICH MAY OCCUR IN THESE PARAMETERS DURING NORMAL REACTOR OPERATION.

1. THE COVER GAS MONITOR HAS A RANGE OF 1 TO 10 SUPERScript 4 MR/H AND WILL READ ABOUT 20 MR/H AT 20 MWT DUE TO A-4L ACTIVITY IN THE COVER GAS. IF PIN HOLE LEAKS OCCUR ONE OR MORE FUEL RODS, THE COVER GAS ACTIVITY WILL INCREASE RAPIDLY AND THEN STABILIZE AT SOME PRESENTLY UNKNOWN LEVEL. THEREFORE, THE LIMIT FOR THIS PARAMETER MUST BE EXPRESSED AS A RATIO RATHER THAN AS AN ABSOLUTE VALUE. A FACTOR OF THREE INCREASE IN THE COVER GAS ACTIVITY WAS SELECTED AS AN APPROPRIATE INITIAL LIMIT.

2818-

3

2. THE REACTIVITY REQUIRED TO REACH A GIVEN POWER LEVEL FROM THE ZERO POWER CONDITIC. AT 350 DEGREES F IS ESTIMATED FROM THE FOLLOWING EQUATION\

$$\Delta K \backslash 0.692 \backslash T \text{ SUBSCRIPT } C - 350 \backslash - 0.001785$$

$$\backslash T \text{ SUBSCRIPT } C - 350 \backslash \text{ SUPERScript } 2$$

$$- 260 \text{ LN } \backslash 1 \text{ PLUS } 77 \text{ P OVER } 460 \text{ PLUS } T \text{ SUB-} \\ \text{SCRIPT } C \backslash - 0.5 \text{ P} - 0.015 \Delta T$$

WHERE\

$\Delta K$  \ REACTIVITY, CENTS

P \ REACTOR POWER, MWT

T SUBSCRIPT C - AVERAGE CORE COOLANT TEMPERATURE  
DEGREE F

$\Delta T$  \ CORE COOLANT TEMPERATURE RISE, DEGREE F

TO EXPEDITIOUSLY ACCOMPLISH THE CALCULATION OF  $\Delta K$ , A SIMPLE COMPUTER PROGRAM WAS FORMULATED WHICH USES THE REACTIVITY MODEL, THE ANTICIPATED CONDITIONS AND THE REFLECTOR CALIBRATIONS TO PREDICT THE REFLECTOR POSITIONS FOR THE COMPUTER CONDITIONS. FOR THE TESTING TO 10 MWT SOME 40 COMPARISONS WERE OBTAINED AND ANALYZED. THE RESULTS INDICATED A MEAN DIFFERENCE BETWEEN MEASURED AND PREDICTED OF 1.3 CENTS WITH A STANDARD DEVIATION OF 4.5 CENTS. THE SELECTION OF PLUS OR MINUS 10 CENTS AS THE DEMARCATION BETWEEN NORMAL AND ANOMALOUS REACTIVITY RESULTS IN APPROXIMATELY 95 \ CONFIDENCE THAT DISPARITIES GREATER THAN THIS VALUE ARE TRULY ANOMALOUS. THESE CONCLUSIONS ARE PARTICULARLY GERMANE SINCE THE CALCULATED REACTOR PARAMETERS OF THE ABOVE EQUATION ARE THOSE WHICH THE EXPERIMENTAL PROGRAM IS DESIGNED TO VERIFY. THE PREDICTIVE SCHEME IS BEING CONTINUALLY IMPROVED AT

4

3. THE MAIN PRIMARY PUMP FLOW RATE CAN BE PREDICTED BY THE FOLLOWING EQUATION\

$$Q = 100 V \text{ OVER } \sqrt{V/400} \text{ PLUS } 6.01$$

Q \ MAIN PRIMARY FLOW RATE, GPM

V \ MAIN PRIMARY PUMP VOLTAGE, VOLTS

THIS EMPIRICAL EQUATION RESULTED FROM AN ACCUMULATION OF DATA TAKEN OVER A WIDE VARIETY OF OPERATING CONDITIONS. A LEAST SQUARE REGRESSION ANALYSIS WAS USED TO OBTAIN THE CURVE FORM AND COEFFICIENTS FROM THE DATA. THE LIMIT OF PLUS OR MINUS 10\ WAS SELECTED TO BE LARGE ENOUGH TO EXCLUDE VARIATIONS DUE TO RANDOM ERRORS IN DATA TAKING AND REPEATABILITY CONSIDERATIONS BUT SMALL ENOUGH TO DETECT INCIPIENT PROBLEMS BEFORE THEY BECOME DETRIMENTAL

AT LOW FLOW RATES, THE APPLIED PUMP VOLTAGE CANNOT BE READ WITH SUFFICIENT REPEATABILITY TO OBTAIN GOOD CORRELATION BETWEEN PREDICTED AND MEASURED FLOW RATES. A LOWER LIMIT OF 1500 GPM HAS THEREFORE BEEN SPECIFIED FOR THE REQUIRED COMPARISONS. THE NORMAL RANGE OF FLOW RATES CALLED FOR DURING REACTOR OPERATION IS 1500 TO 3000 GPM.

4. THE UPPER REACTOR VESSEL OUTLET TEMPERATURE MUST BE COMPARED TO TEMPERATURE MEASURED IN THE MAIN PRIMARY COOLANT SYSTEM TO IDENTIFY ANY UNEXPLAINED BEHAVIOR SINCE THE PLANNED TESTS WILL RESULT IN A WIDE RANGE OF NORMAL VALUES FOR THIS TEMPERATURE. ANY SIGNIFICANT CHANGE IN CORE COOLING DUE TO AN INCREASE IN CORE BYPASS FLOW WILL CAUSE THIS TEMPERATURE COMPARISON TO EXCEED THE SPECIFIED LIMIT AND WILL BE DETECTED.

818-5

B. INITIAL OPERATIONS UP TO A POWER LEVEL OF 1 MWO HAVE BEEN COMPLETED WITHOUT ANY INDICATION OF FISSION GAS LEAKS FROM THE FUEL BY THE GROSS COVER GAS MONITOR. THE SENSITIVITY OF THE GROSS COVER GAS MONITOR HAS BEEN DEMONSTRATED AS REQUIRED BY 3.3.L OF THE TECHNICAL SPECIFICATIONS. HOWEVER, THERE IS NO OPERATING EXPERIENCE WITH LEAKY FUEL RODS THAT CAN BE USED TO ESTABLISH FIRM QUANTITATIVE LIMITS ON ACCEPTABLE COVER GAS ACTIVITY LEVELS, COMPOSITION OF FISSION PRODUCTS IN THE COVER GAS, OR FISSION PRODUCTS IN THE SODIUM. EXPERIENCE WITH OPERATING FAST-SPECTRUM SODIUM-COOLED OXIDE FUELED REACTORS (REFS. 1 AND 2) INDICATES THAT LEAKY FUEL RODS SHOULD BE EXPECTED BUT THAT CONTINUED OPERATION IN THE PRESENCE OF "LEADERS" DOES NOT PRESENT A SAFETY PROBLEM. FOR EXAMPLE, RAPSDIE DETECTED ITS FIRST "LEAKER" WITH APPROXIMATELY 10 MWD/KG FUEL BURN-UP AND HAS SAFELY OPERATED TO FUEL BURNUPS IN EXCESS OF 40 TO 50 MWD/KG WITH NO INDICATION OF GROSS FUEL FAILURE. (REF. 3)

THE PROPOSED SPECIFICATIONS 3.13.A.1 AND B PROVIDE ASSURANCE THAT THE REACTOR WILL NOT BE OPERATED IF THE GROSS COVER GAS

MONITOR CANNOT DETECT THE RELEASE OF FISSION GAS FROM ONE ADDITIONAL FUEL ROD. AS DISCUSSED IN THE BASES TO 3.13.B, FUEL FAILURES AS DEFINED IN 3.3.K ARE NOT EXPECTED TO OCCUR. NONETHELESS, THE FIRST POSITIVE INDICATION OF RELEASE OF FISSION GAS FROM A FUEL ROD WILL BE TREATED AS EVIDENCE OF A POSSIBLE FUEL FAILURE AS DEFINED IN 3.3.K OF THE TECHNICAL SPECIFICATIONS. A COVER GAS SAMPLE WILL BE TAKEN FOR SPECTRAL ANALYSIS. TWO OR MORE GUINEA PIG RODS UNDER THE MOST SEVERE REACTOR CONDITIONS WILL BE EXAMINED IN THE REACTOR CELL TO VERIFY THAT THE FUEL IS NOT OPERATING NEAR A DAMAGE THRESHOLD.

COVER GAS SAMPLES WILL BE TAKEN AND ANALYZED FOR FISSION PRODUCTS. THE

IT IS EXPECTED THAT THE RESULTS FROM THE VARIOUS SURVEILLANCE FUNCTIONS WILL INDICATE THAT THE OBSERVED INCREASE IN COVER GAS ACTIVITY WAS THE RESULT OF A PIN HOLE LEAK IN FUEL ROD AND REACTOR OPERATIONS WOULD RESUME. IT IS ALSO POSSIBLE THAT ADDITIONAL INVESTIGATION WITH THE REACTOR OPERATING AT REDUCED POWER WOULD BE REQUIRED TO OBTAIN SUFFICIENT INFORMATION TO ALLOW RESUMPTION OF NORMAL REACTOR OPERATION. SUBSEQUENT REACTOR OPERATION WILL REQUIRE CAREFUL SURVEILLANCE OF GROSS COVER GAS ACTIVITY AND COMPOSITION.

THE SAFETY SIGNIFICANCE OF OPERATING WITH AN UNDETECTED FUEL ROD FAILURE HAS BEEN DISCUSSED PREVIOUSLY \REF. 4\.

IN SUMMARY, SEFOR HAS BEEN SUCCESSFULLY OPERATED TO A POWER LEVEL OF 15 MWT WITHOUT INDICATION OF LOSS OF CLAD INTEGRITY. CONSEQUENTLY, THERE IS NO OPERATING EXPERIENCE AT SEFOR THAT CAN BE USED TO ESTABLISH NUMERICAL LIMITS ON ALL OF THE SURVEILLANCE FUNCTIONS ASSOCIATED WITH AN INVESTIGATION OF A POSSIBLE FUEL FAILURE. EXPERIENCE AT EBR-II \REF. 3,6,7\ RAPSODIE \REF. 1\, AND BR-5 \REF. 8\ INDICATE THAT SYSTEM CHARACTERISTICS HAVE AN IMPORTANT INFLUENCE ON THE BEHAVIOR OF VARIABLES USED TO DETERMINE THE EXTENT OF A LOSS OF FUEL CLAD INTEGRITY. QUANTITATIVE LIMITS THAT CAN BE ESTABLISHED BASED ON OPERATING EXPERIENCE AT SEFOR AND SIMILAR REACTOR FACILITIES ARE INCLUDED IN THE PROPOSED SPECIFICATIONS. ADDITIONAL LIMITS THAT WILL BE DEVELOPED BASED ON OPERATING EXPERIENCE AT SEFOR WILL BE REPORTED IN THE QUARTERLY OPERATING REPORTS OR IN SPECIAL REPORTS AS REQUIRED BY THE TECHNICAL SPECIFICATIONS.

2818-7

THE PROPOSED LIMITS ON ANOMALIES OTHER THAN THOSE ASSOCIATED WITH THE REACTOR COVER GAS ACTIVITY ARE BASED ON ACTUAL OPERATING EXPERIENCE AT SEFOR. AS DISCUSSED IN THE BASES FOR THESE PROPOSED LIMITS, THE VALUES HAVE BEEN SELECTED SO THAT THE PROPER ACTION IS TAKEN ON VARIATIONS THAT ARE STATISTICALLY SIGNIFICANT. ACTIONS TO BE TAKEN IN THE EVENT ANY OF THE PROPOSED LIMITS ARE REACHED ARE COVERED IN 4.9 OF THE TECHNICAL SPECIFICATIONS.

#### REFERENCES\

1. G. KAYSER, "PROBLEMS DUE TO FISSION PRODUCTS IN CIRCUITS OF SODIUM-COOLED FAST REACTORS IN THE EVENT OF CAN FRACTURES," EURFNR-593 \ORIGINAL REPORT NO. DRP/SEMTR/CAD.68.R.575\, NUCLEAR RESEARCH CENTER CADARACHE AND SACLAY \FRANCE\, DECEMBER, 1968.
2. A. I. LEIPUNSKII, ET AL., "EXPERIENCE GAINED FROM THE OPERATION OF THE BR-5 REACTOR, 1964-5," PAPER 2/3 OF PROCEEDINGS OF THE LONDON CONFERENCE ON FAST BREEDER REACTORS, MAY, 1966, PP 171-185
3. DR. STANLEY J. STACHURA \CADARACHE REPRESENTATIVE, AEC-EURATOM FAST REACTOR EXCHANGE PROGRAM\, "MONTHLY REPORT NO. 18, MAY, JUNE, 1969", PP 3,4. 2818-8
4. SEFOR FDSAR, SUPPLEMENT 21, P. 1-10