APPENDIX D

DATA PLOTS

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Test PCM-3 data for the power calibration and the five DNB cycles were processed to obtain plots of the measured parameters The transducer outputs were first recorded as an analog signal on magnetic tape. This tape was then processed by the PBF PDP-15 reduction system into a digital record of the test and converted to standard computer format on the IBM 360. The MAC/RAN III Time Series Analysis Program was then used to further process and convert the voltage signal into engineering units. Appendix B describes the conversion equations used.

The transducer outputs of the fuel centerline temperature on Rod UTA-0011 and the internal pressure on Rod UTA-0013 were first calibrated with incorrect equations. To correct this error, equations were fit to the calibration curves with volts as the dependent variables. The resulting calibration equations used were:

(1) Fuel centerline temperature, Rod UTA-0011

$$K = 341.93 + 3442.5\ (V) - 2254.6\ (V)^2 + 2412.97\ (V)^3.$$

(2) Internal pressure, Rod UTA-0013

$$MPa = 5.190 + 32.847\ (V) + 3.327\ (V)^2 - 3.285\ (V)^3.$$

By applying these new equations to the previously calibrated results, the data were returned to the recorded units of volts. The proper calibration equation was then used to obtain the final results shown in the time plots in this appendix.

The final calibration curve was double valued at the upper extremes for the fuel centerline temperature so that a polynomial curve fit was not possible for the full range. The minimum values of voltage for this transducer were between 0.078 ad 0.63 V. The values between 0.078 and 0.55 V are single valued, so this part of the curve was used in the polynomial regression program. Thus, a possible error occurred at the extremes of the curve.

Time plots (Figures D-1 through D-115) during Test PCM-3 are presented in this appendix for fuel rod peak power (kW/m), reactor core power (MW), plenum temperature (K), self-powered neutron detector signals (nA), coolant inlet temperature (K), coolant outlet temperature (K), fuel centerline temperature[a] (K), fuel rod internal pressure (MPa), coolant temperature increase (K), cladding surface temperature (K), cladding elongation (mm), and coolant flow rate (l/s)[b].

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a. An error of about -7% during low power operation, about ±1% during high power operation, and about ±3% during film boiling was induced in the fuel thermocouple calibration for Rod UTA-0011 during a required recalibration.

b. Conversion factors from (l/s) to kg/s·m^2 for Rods UTA-0011, UTA-0013, and A-0021: 5788, and for Rod A-0015: 5573.

POWER CALIBRATION

Reactor shutdown occurred at 5400 seconds to allow correction to thermocouples measuring temperature rise on Rod A-0021. Startup was at 7800 seconds.

Zero time corresponds to Test IRIG time 14:16:00, June 24, 1976.

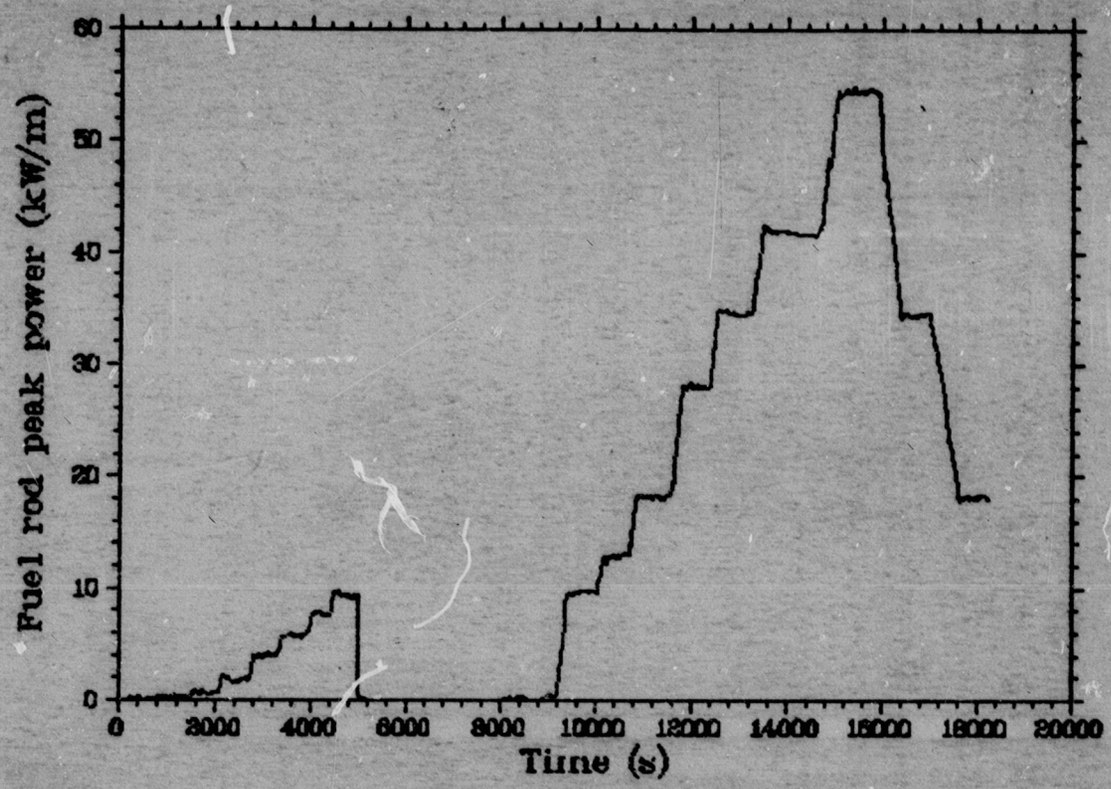


Fig. D-1 Fuel rod peak power history during Test PCM-3 power calibration.

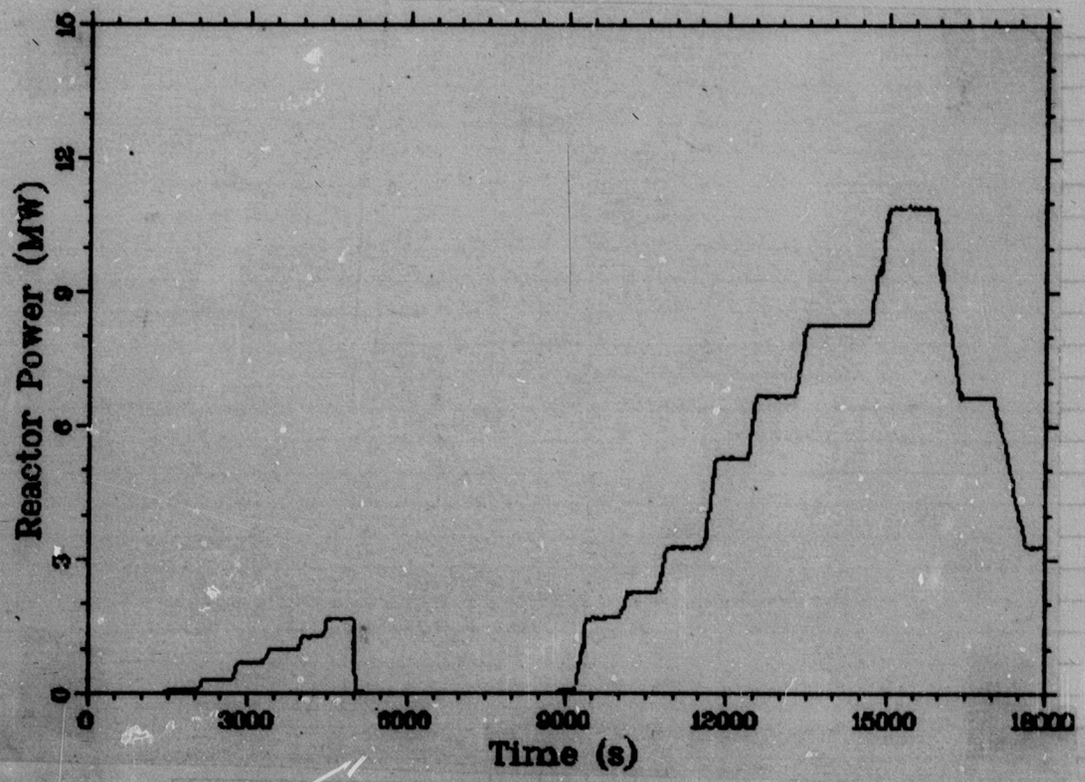


Fig. D-2 PBF core power history during Test PCM-3 power calibration.

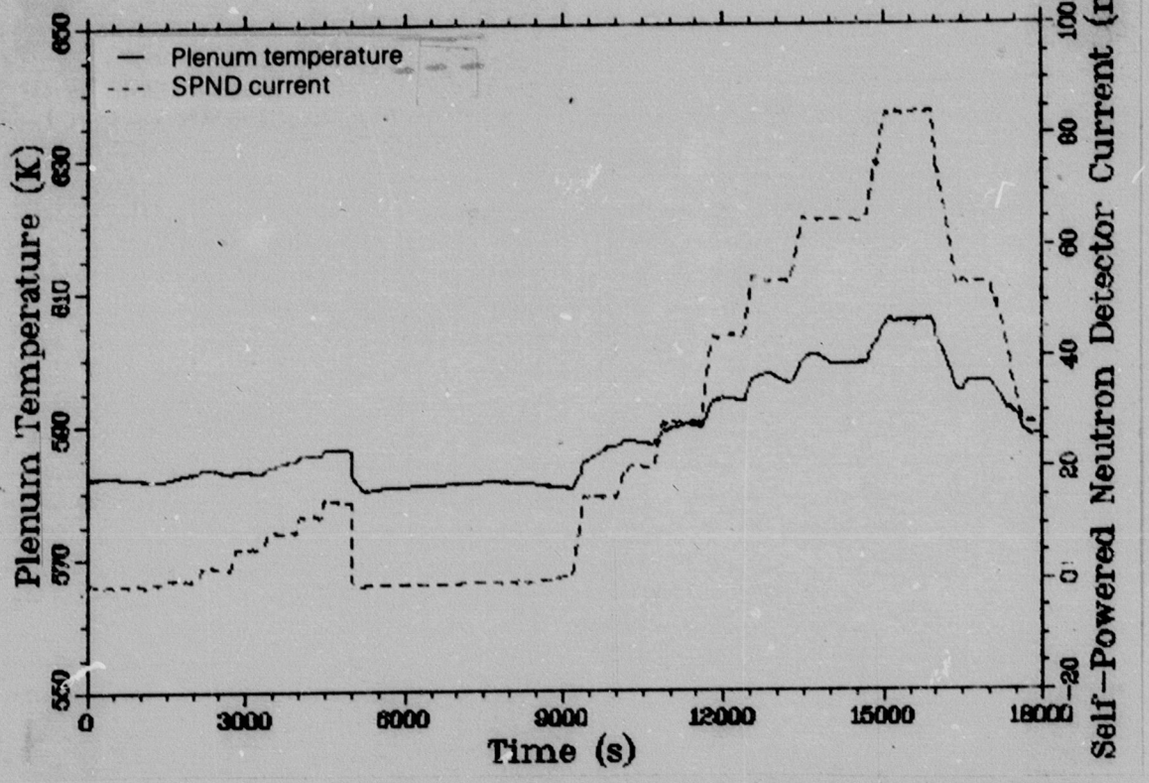


Fig. D-3 Plenum temperature and SPND current at 0.31-m elevation histories during Test PCM-3 power calibration.

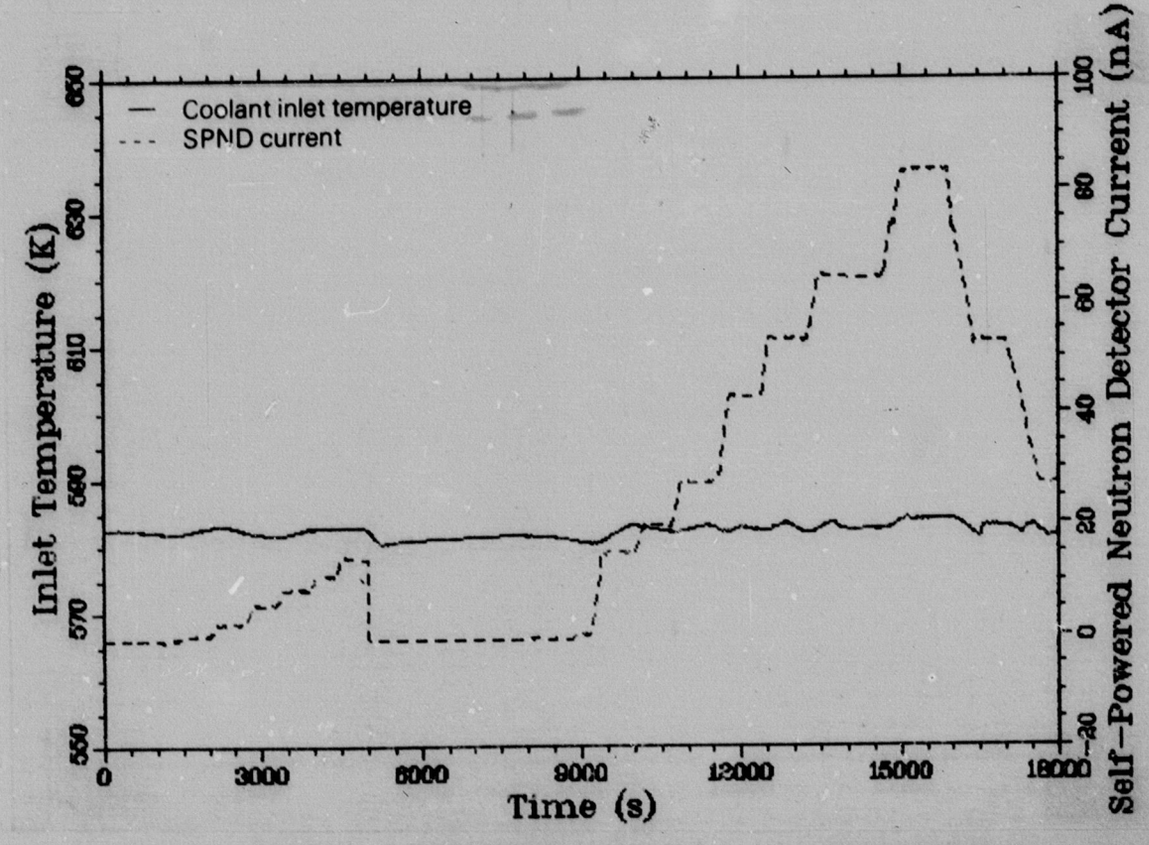


Fig. D-4 Coolant inlet temperature No. 1 and SPND current at 0.47-m elevation histories during Test PCM-3 power calibration.

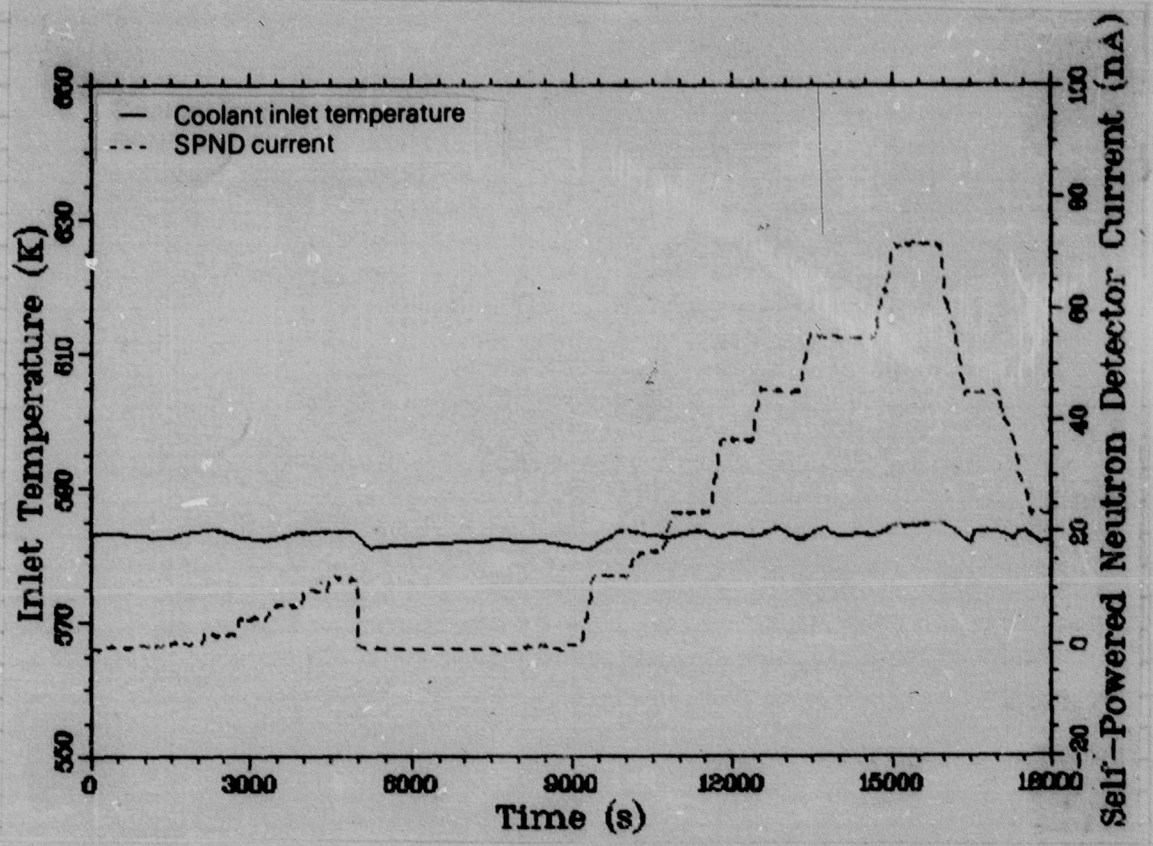


Fig. D-5 Coolant inlet temperature No. 2 and SPND current at 0.63-m elevation histories during Test PCM-3 power calibration.

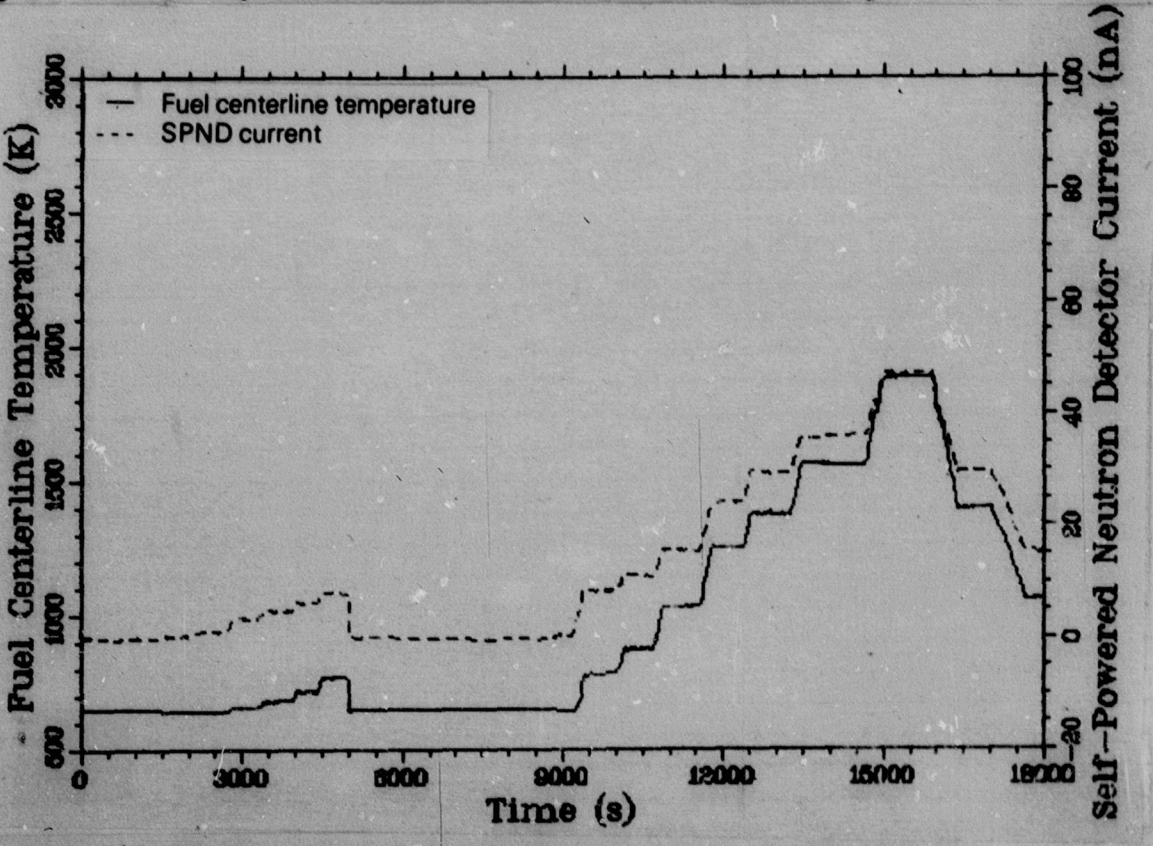


Fig. D-6 Rod UTA-0011 fuel centerline temperature and SPND current at 0.79-m elevation histories during Test PCM-3 power calibration.

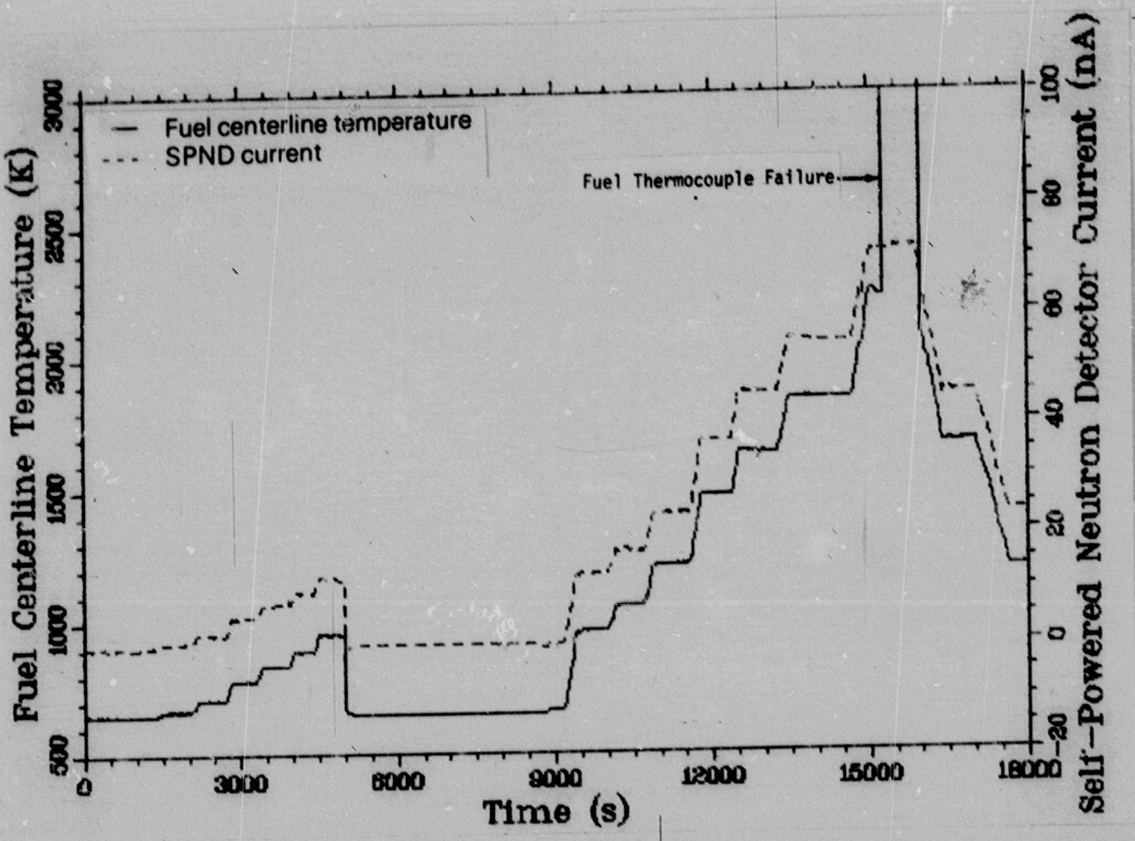


Fig. D-7 Rod UTA-0013 fuel centerline temperature and SPND current at 0.63-m elevation histories during Test PCM-3 power calibration.

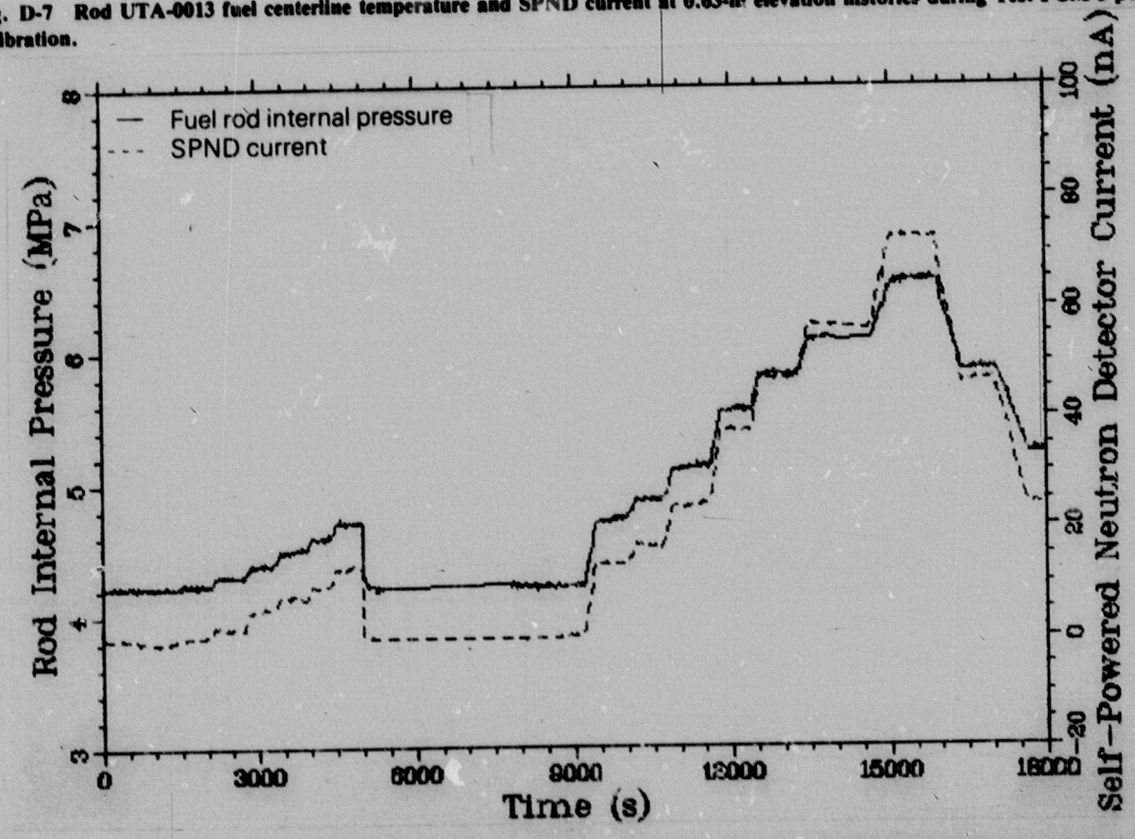


Fig. D-8 Rod UTA-0011 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 power calibration.

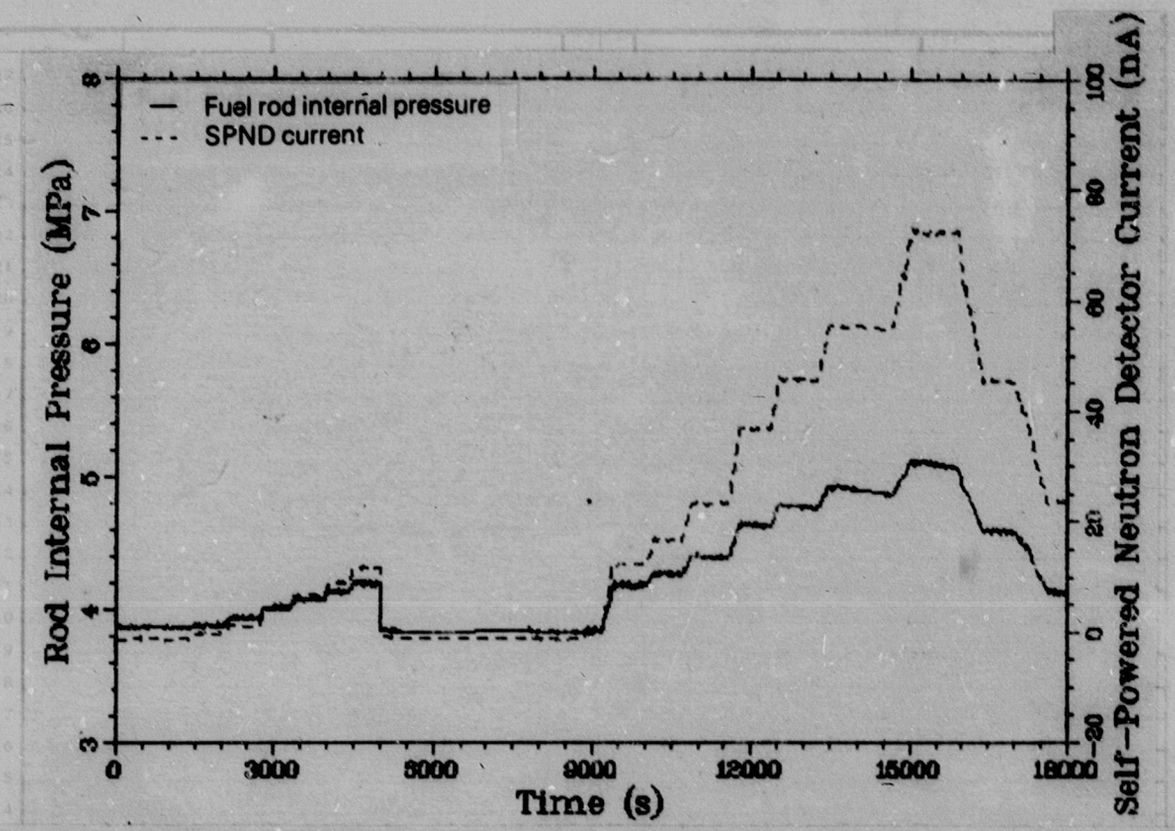


Fig. D-9 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.69-m elevation histories during Test PCM-3 power calibration.

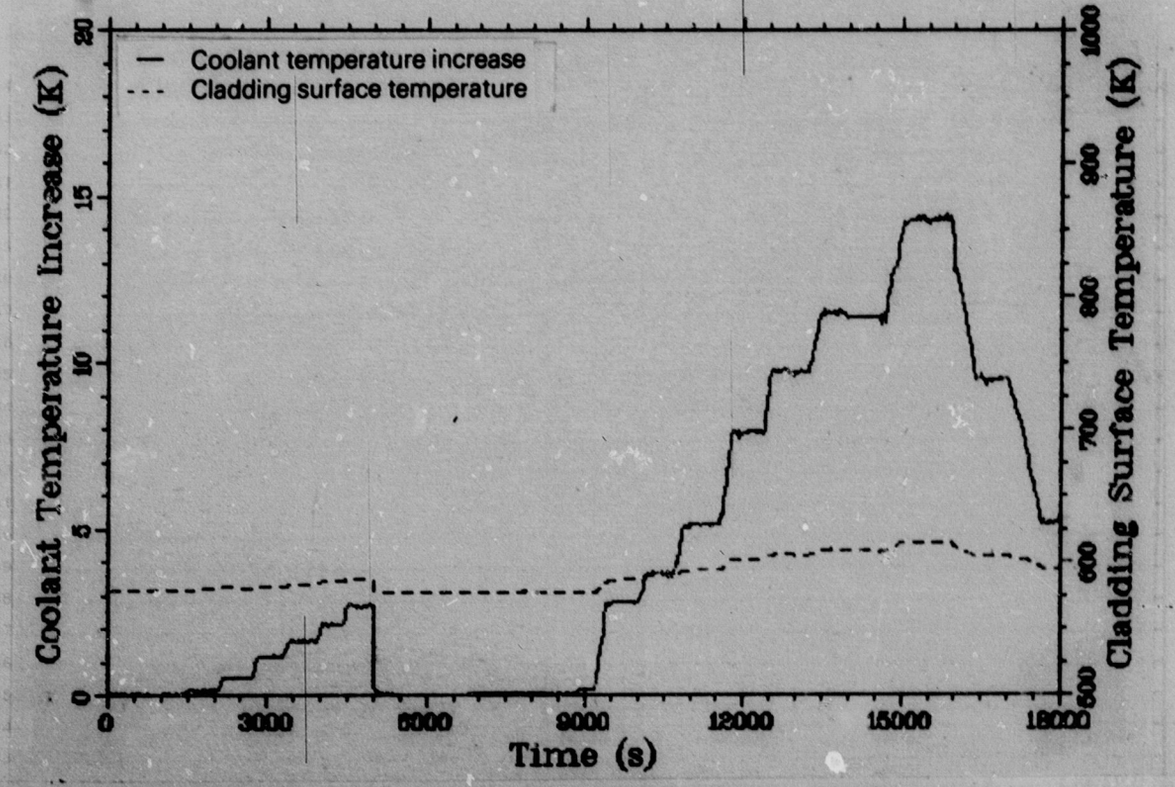


Fig. D-10 Rod UTA-0011 coolant temperature increase and cladding surface temperature at 0.69-m and 9-degree location histories during Test PCM-3 power calibration.

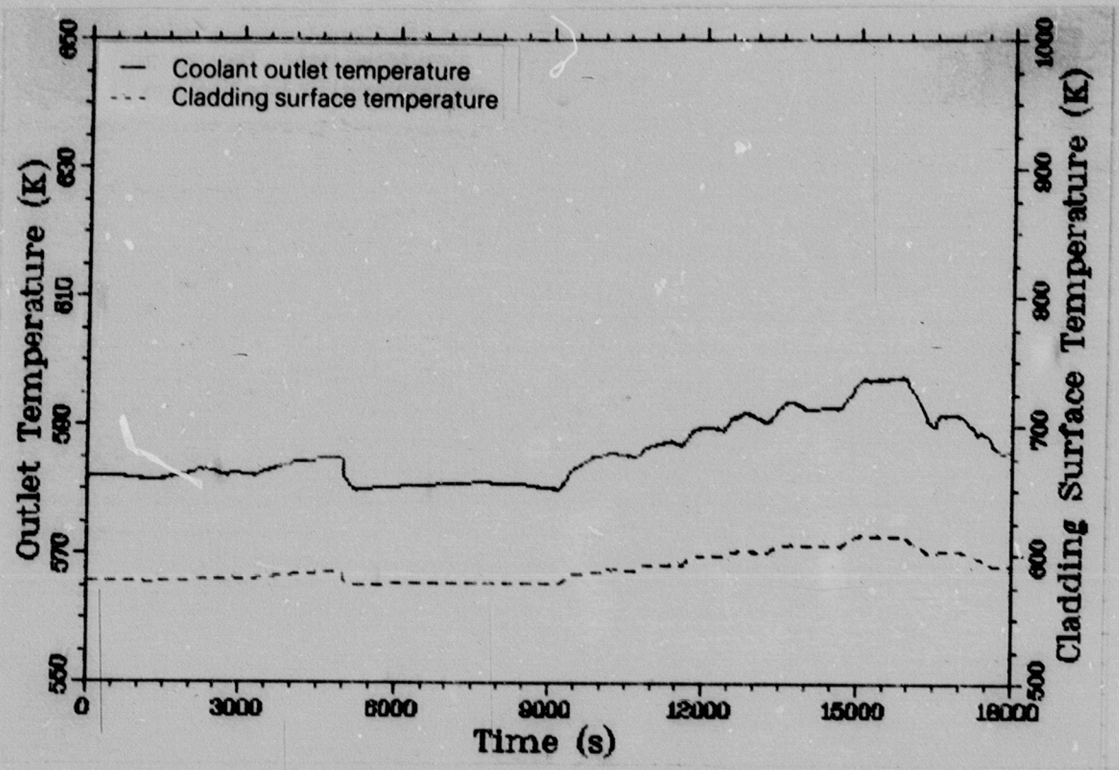


Fig. D-11 Rod UTA-0011 coolant outlet temperature and cladding surface temperature at 0.74-m and 90-degree location histories during Test PCM-3 power calibration.

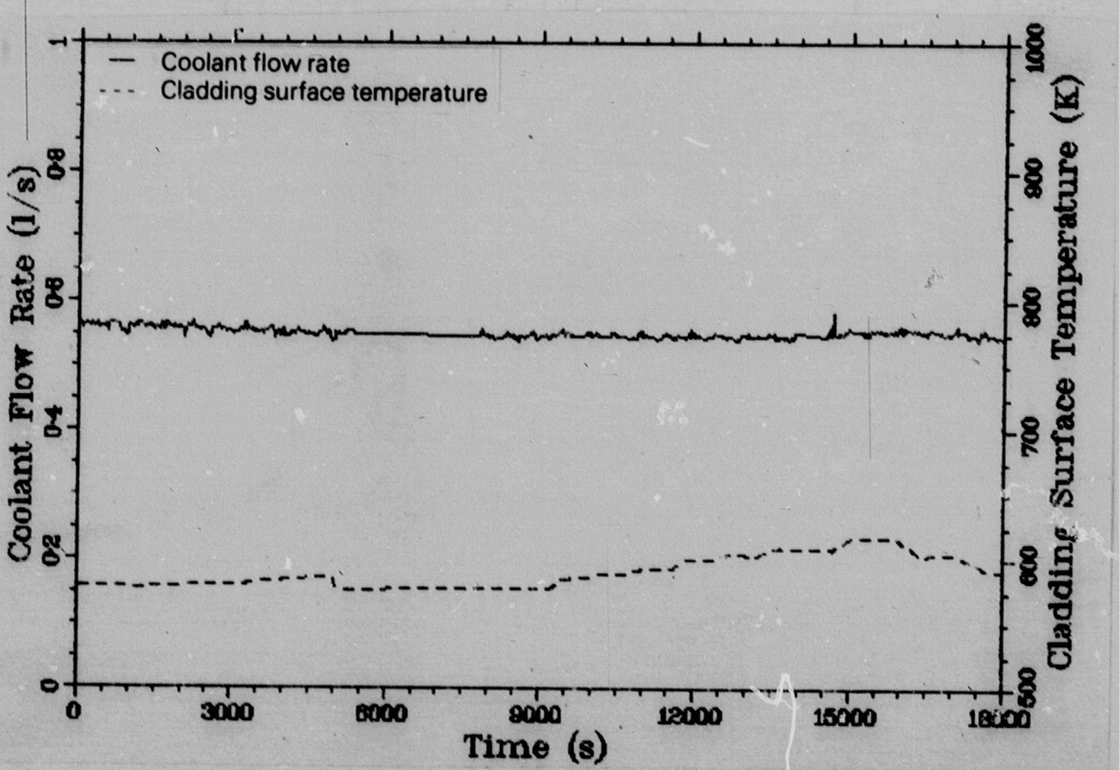


Fig. D-12 Rod UTA-0011 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 power calibration.

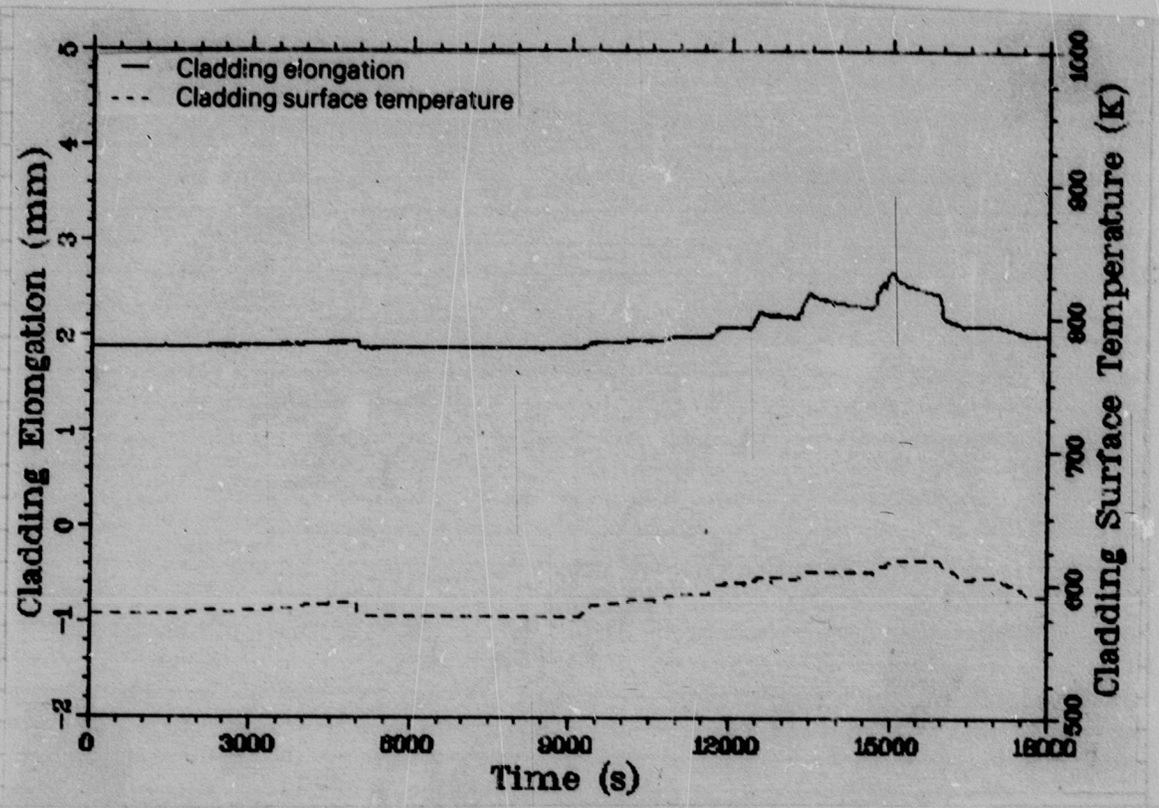


Fig. D-13 Rod UTA-0011 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 power calibration.

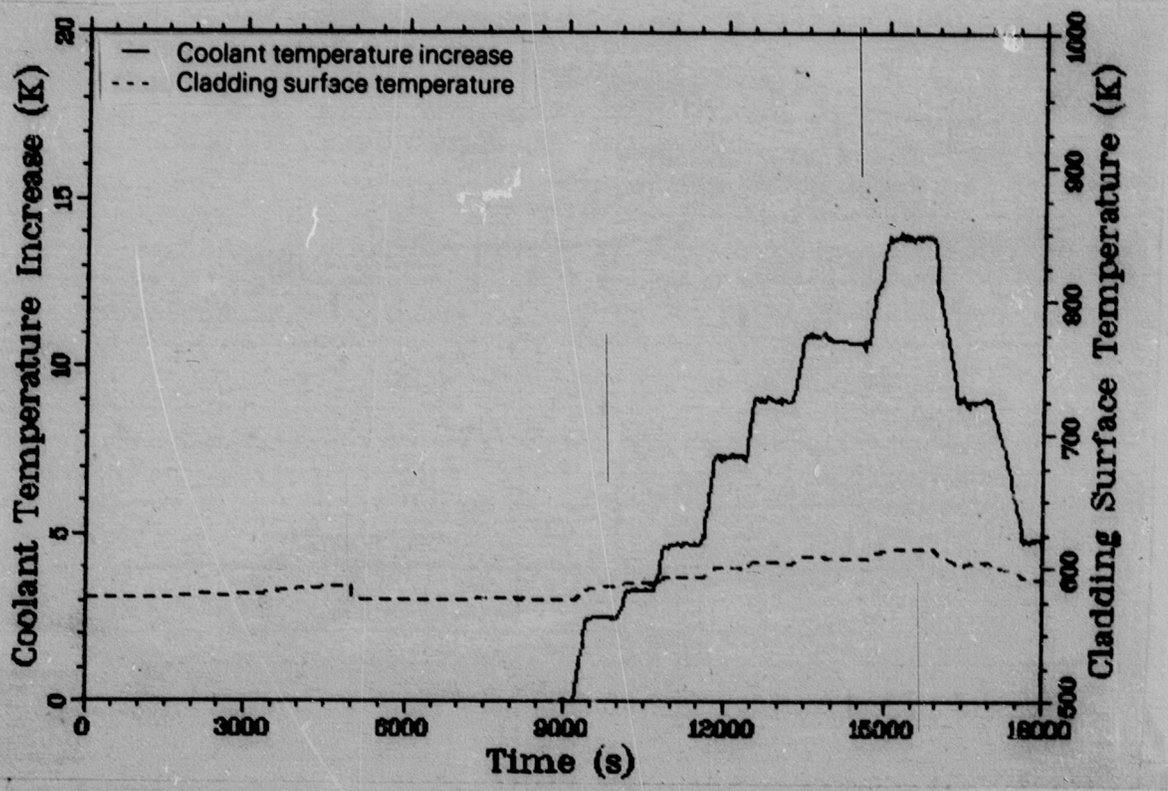


Fig. D-14 Rod A-0021 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 power calibration.

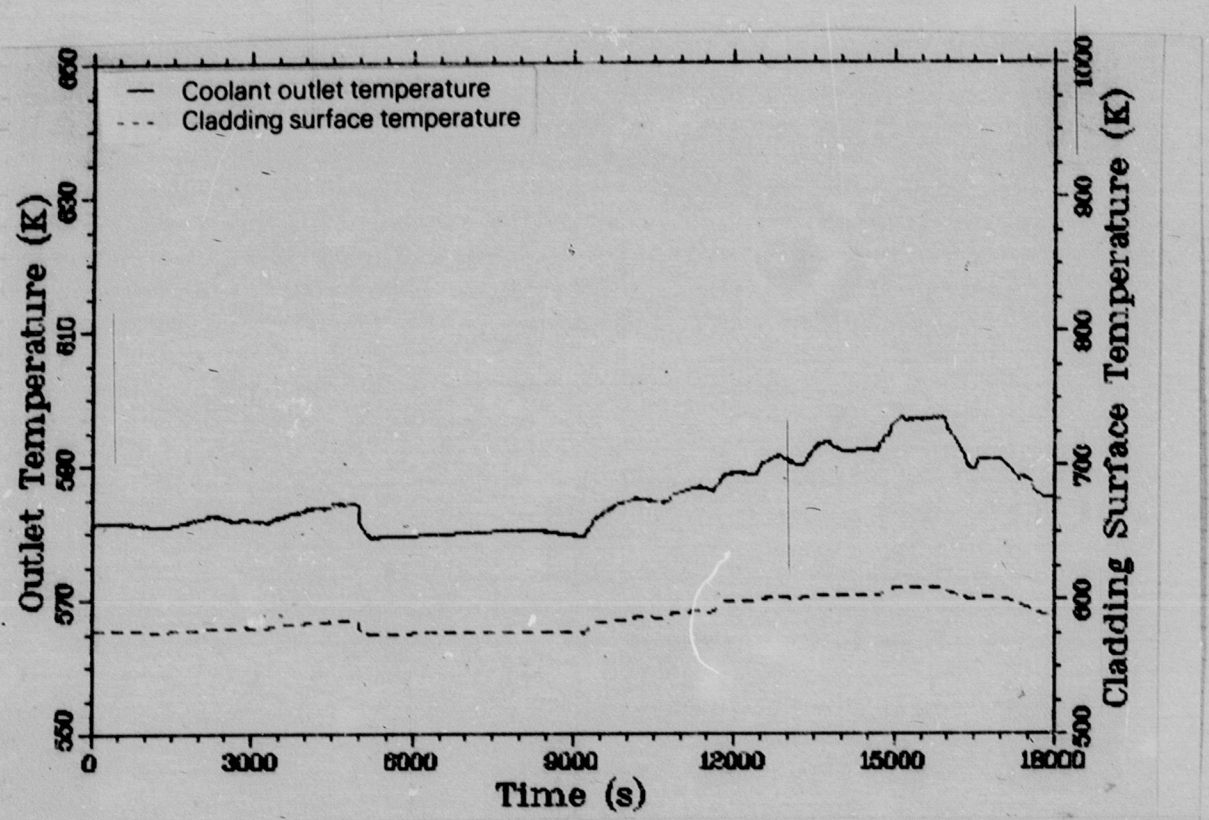


Fig. D-15 Rod A-0021 coolant outlet temperature and cladding surface temperature at 0.63-m and 90-degree location histories during Test PCM-3 power calibration.

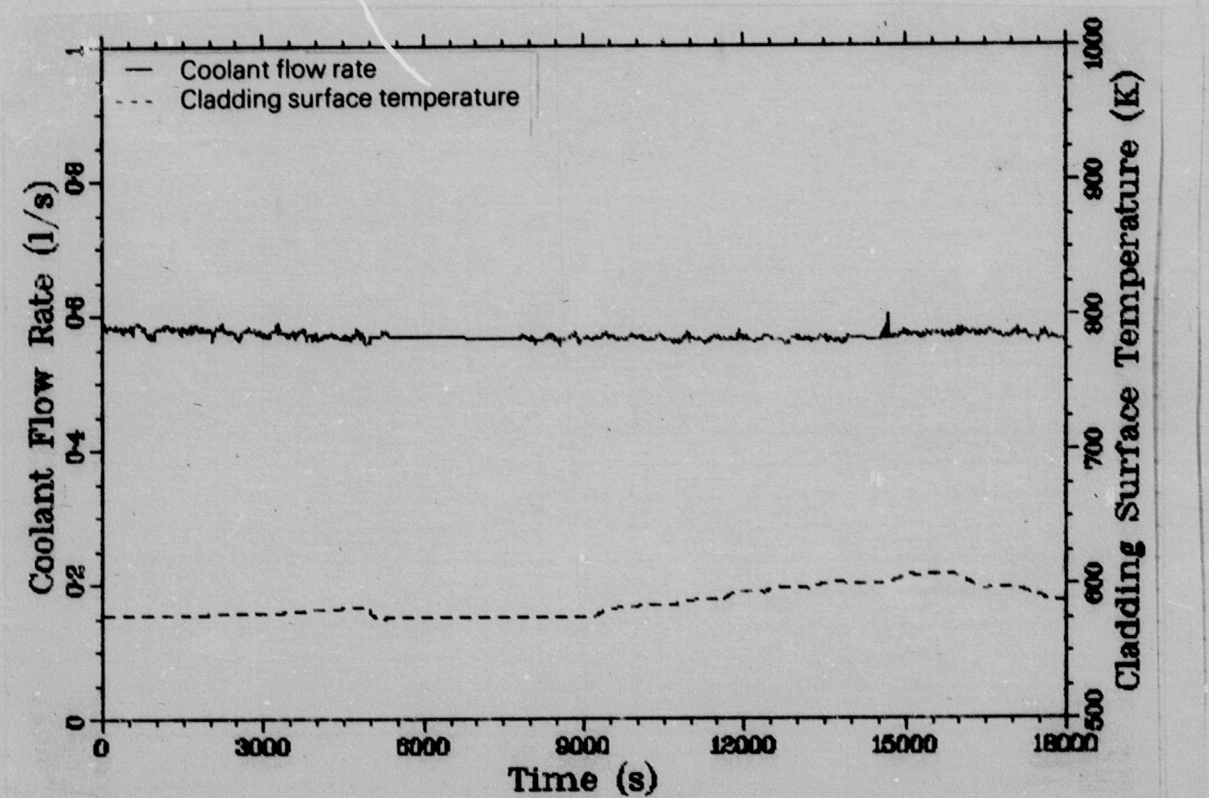


Fig. D-16 Rod A-0021 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 power calibration.

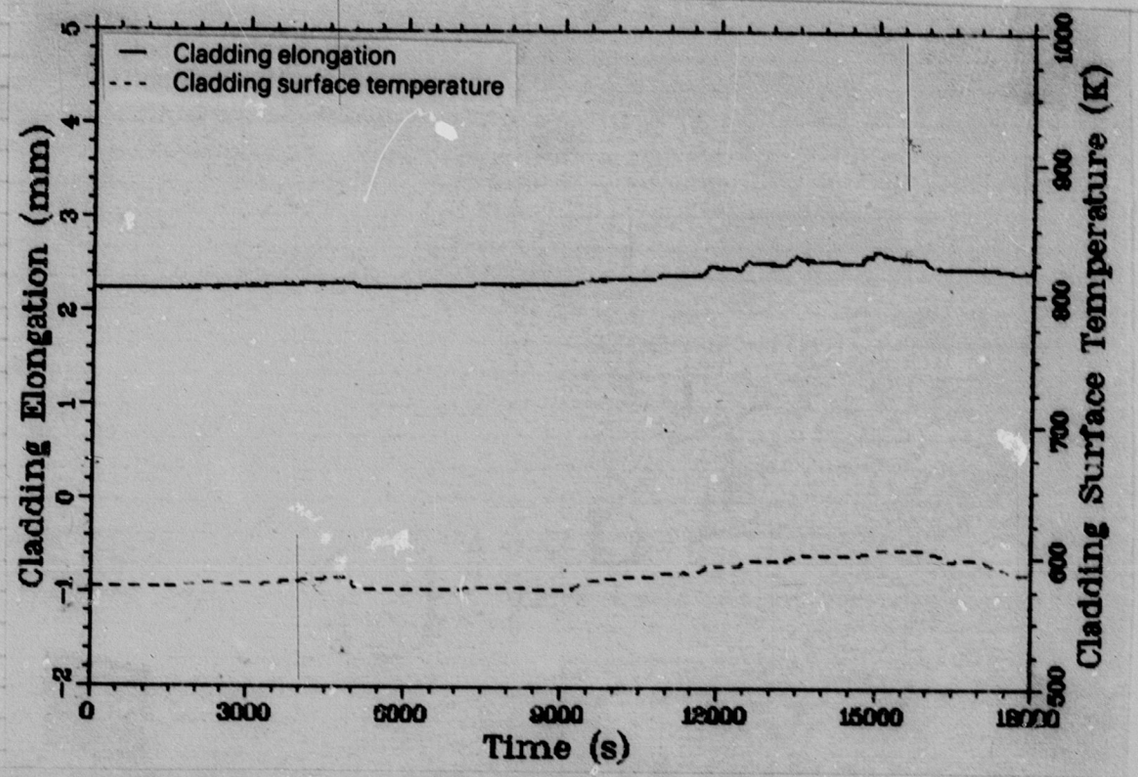


Fig. D-17 Rod A-0021 cladding elongation and cladding surface temperature at 0.89-m and 270-degree location histories during Test PCM-3 power calibration.

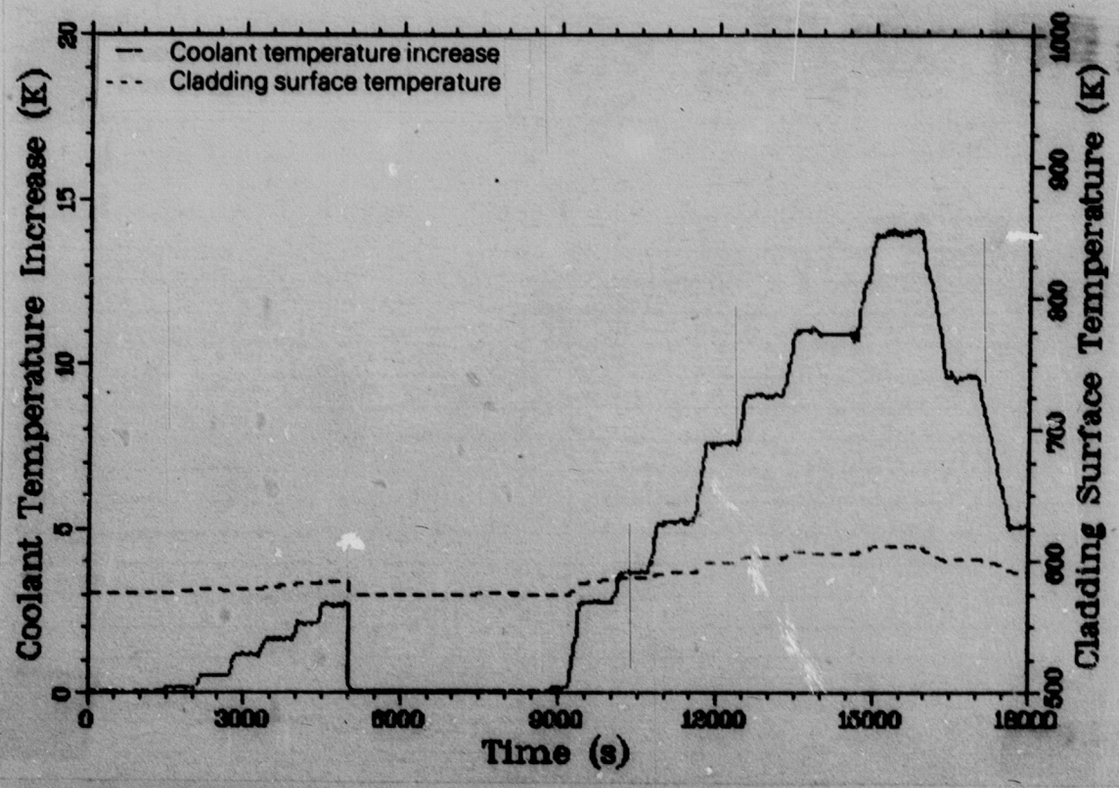


Fig. D-18 Rod UTA-0013 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 power calibration.

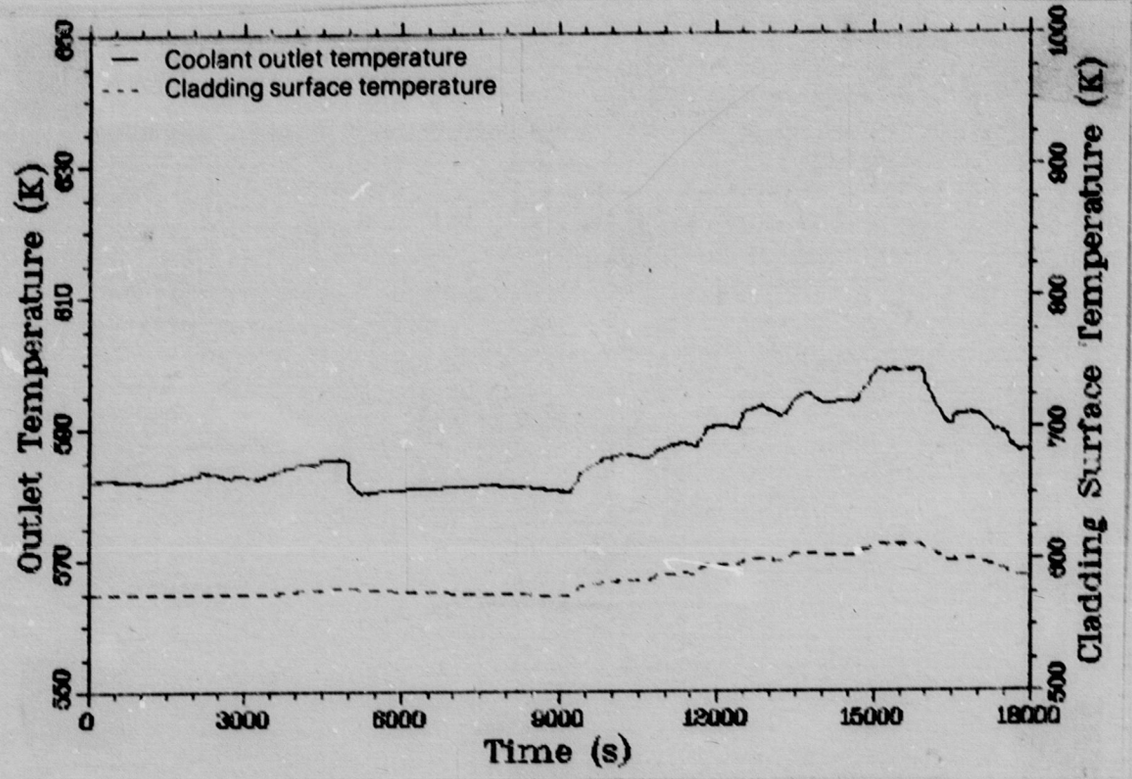


Fig. D-19 Rod UTA-0013 coolant outlet temperature and cladding surface temperature at 0.48-m and 90-degree location histories during Test PCM-3 power calibration.

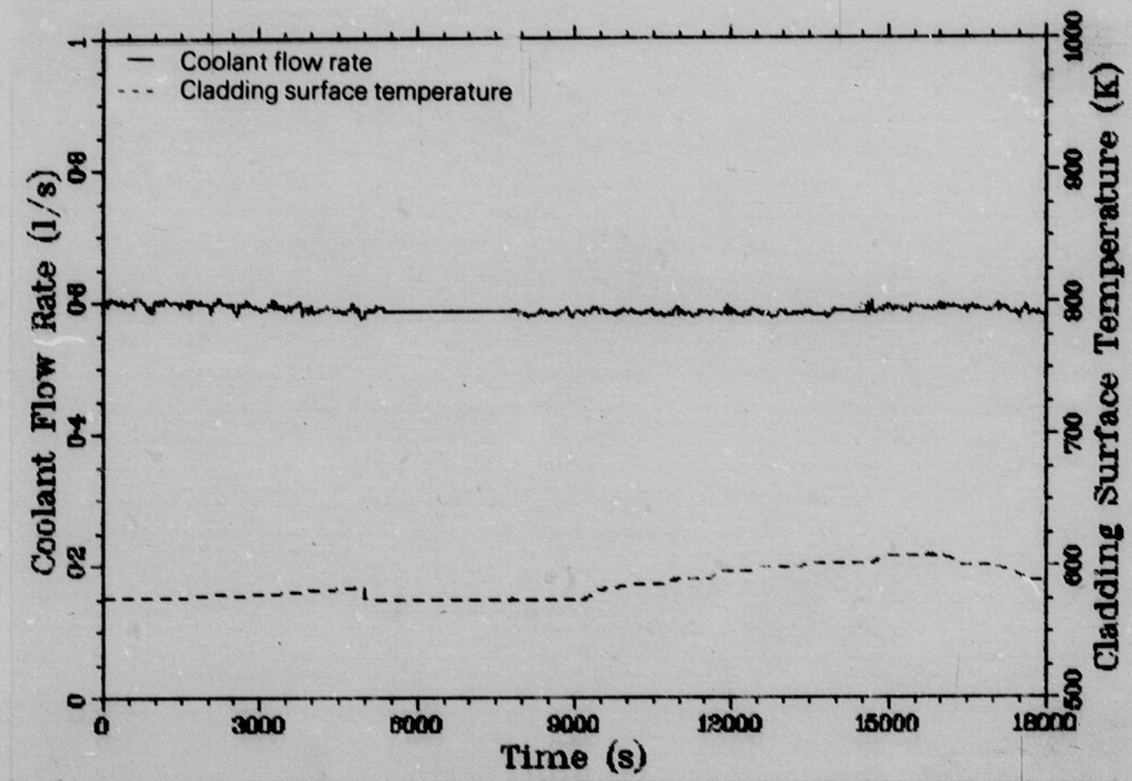


Fig. D-20 Rod UTA-0013 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 power calibration.

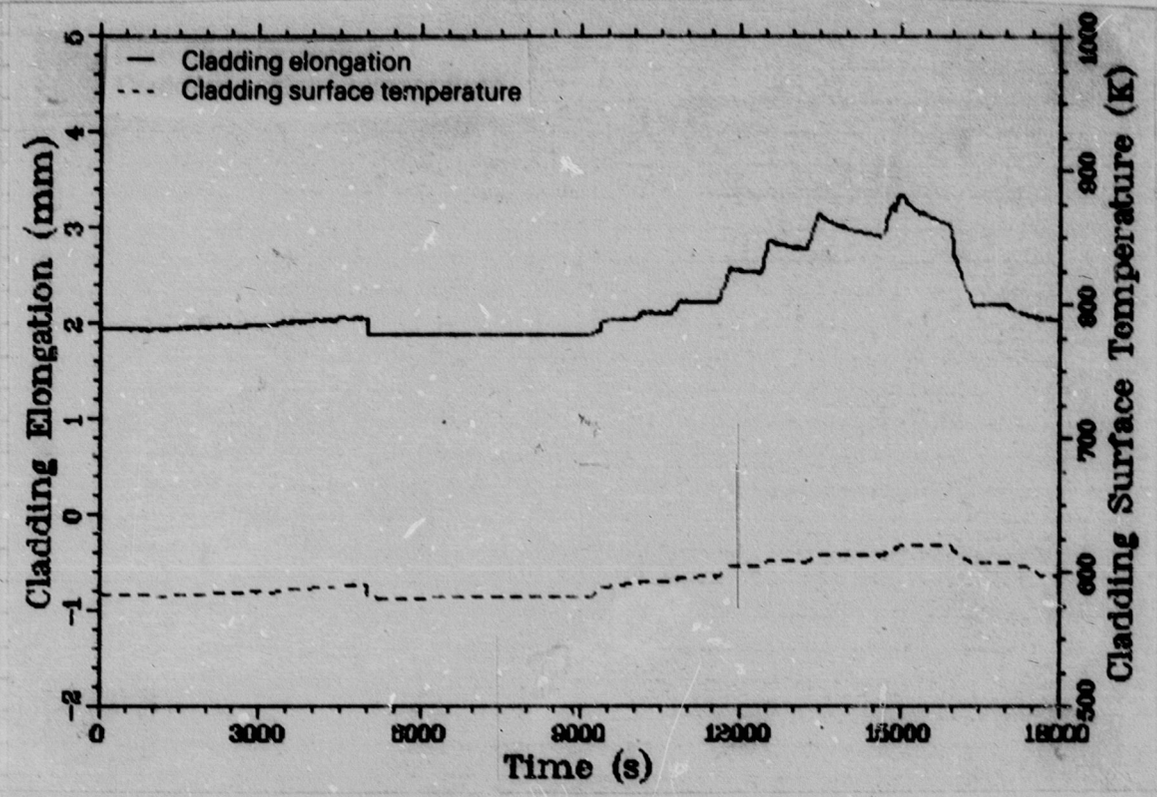


Fig. D-21 Rod UTA-0013 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 power calibration.

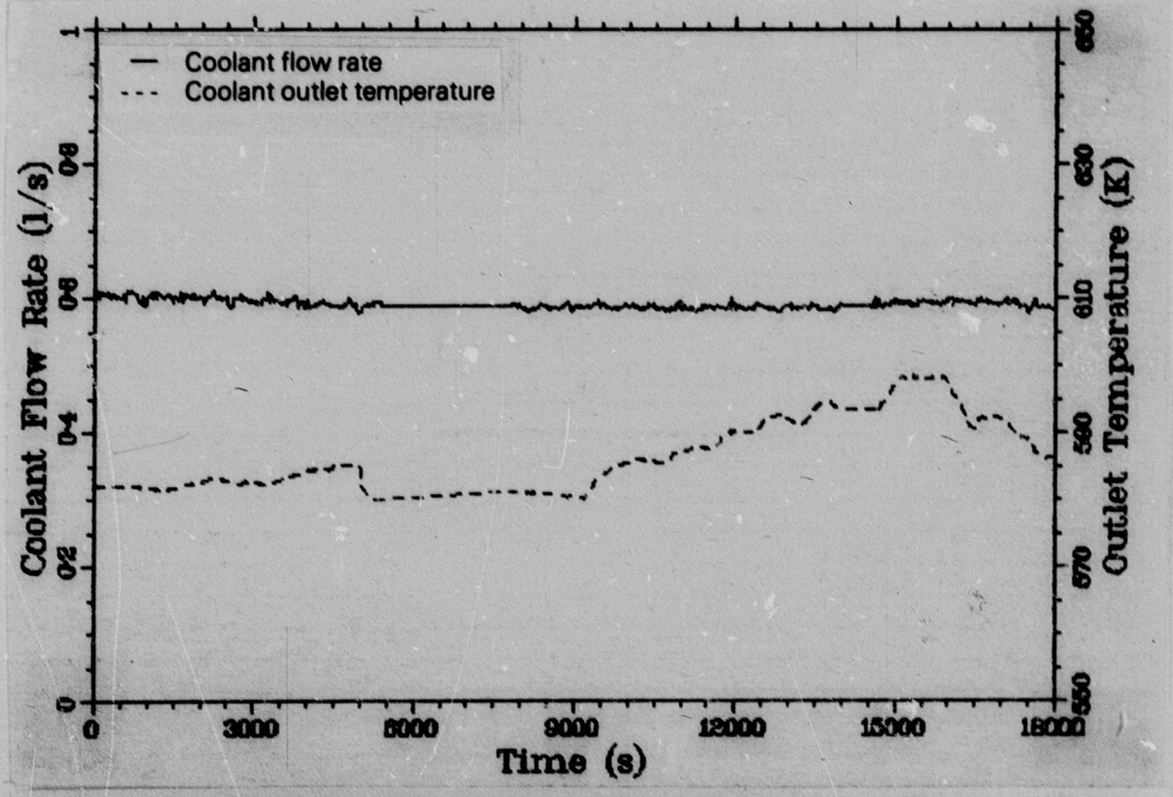


Fig. D-22 Rod A-0015 coolant flow rate and coolant outlet temperature histories during Test PCM-3 power calibration.

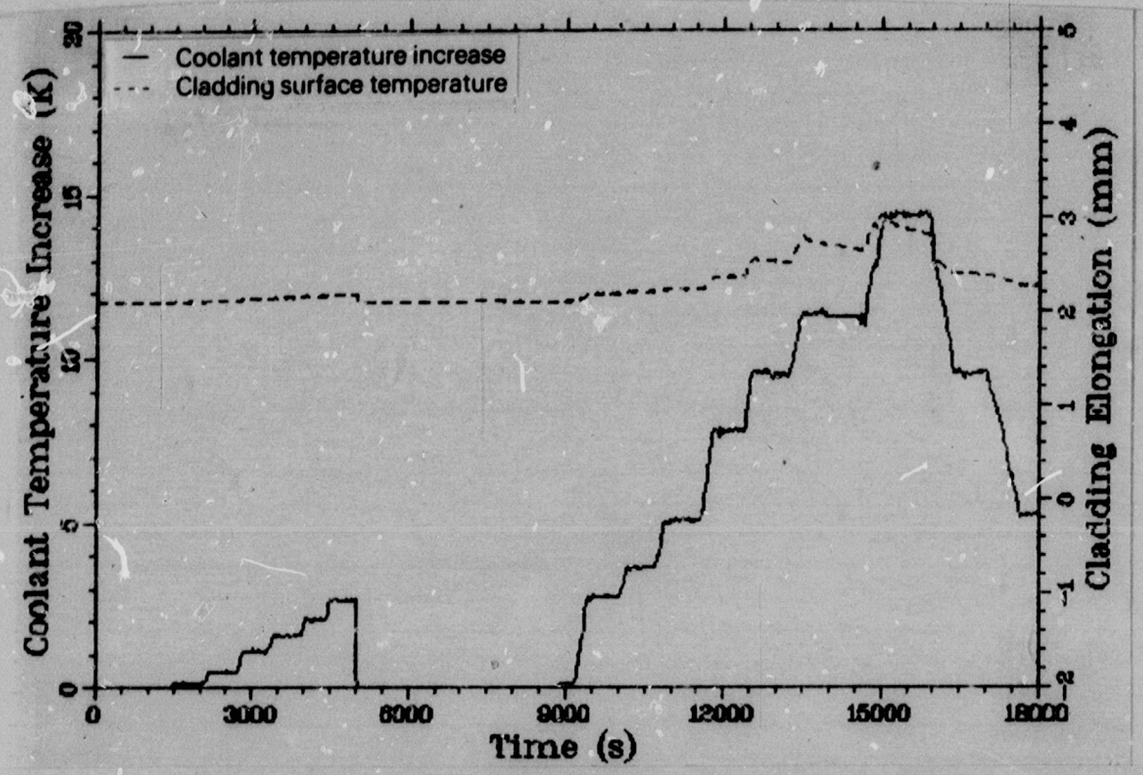
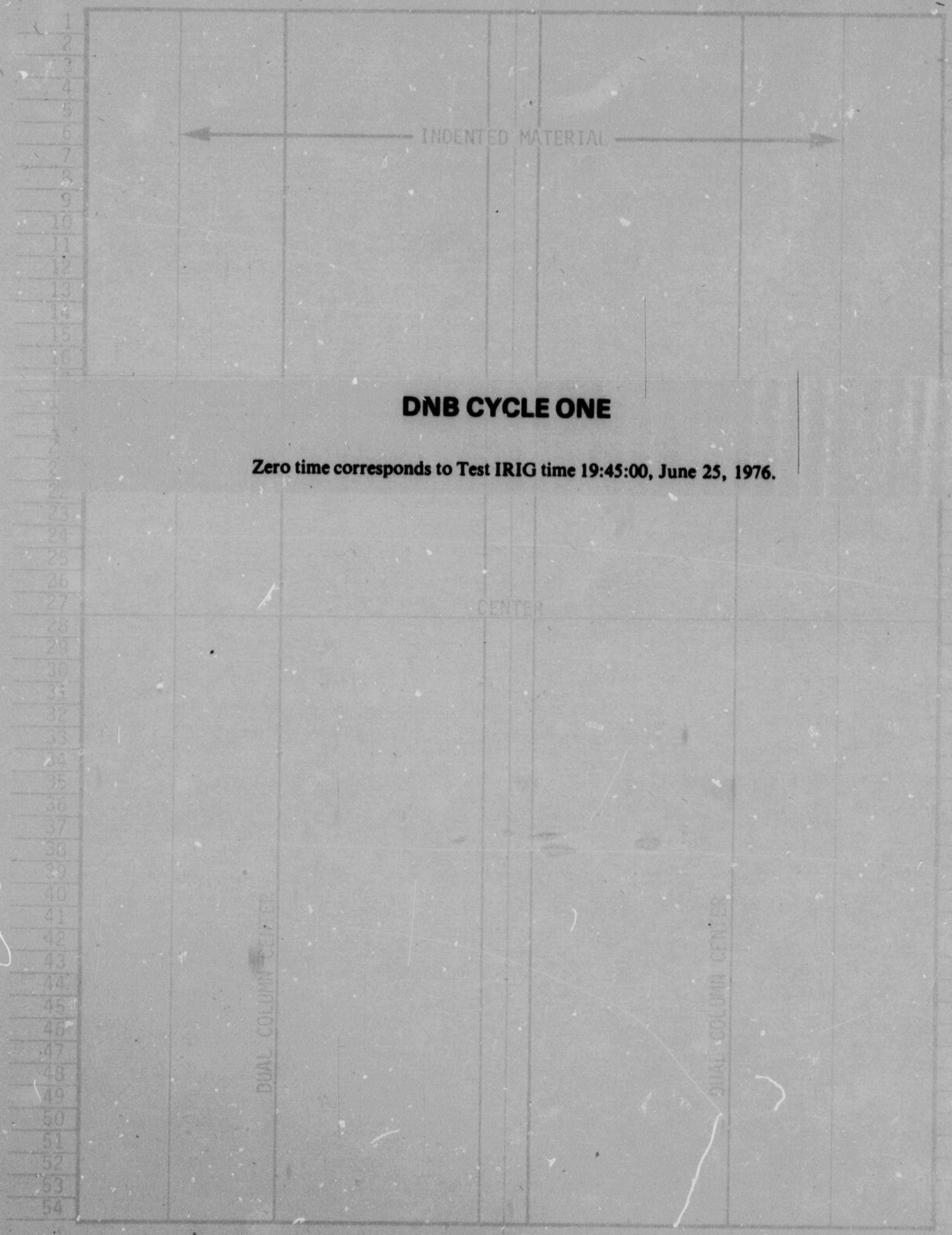


Fig. D-23 Rod A-0015 coolant temperature increase and cladding elongation histories during Test PCM-3 power calibration.



DNB CYCLE ONE

Zero time corresponds to Test IRIG time 19:45:00, June 25, 1976.

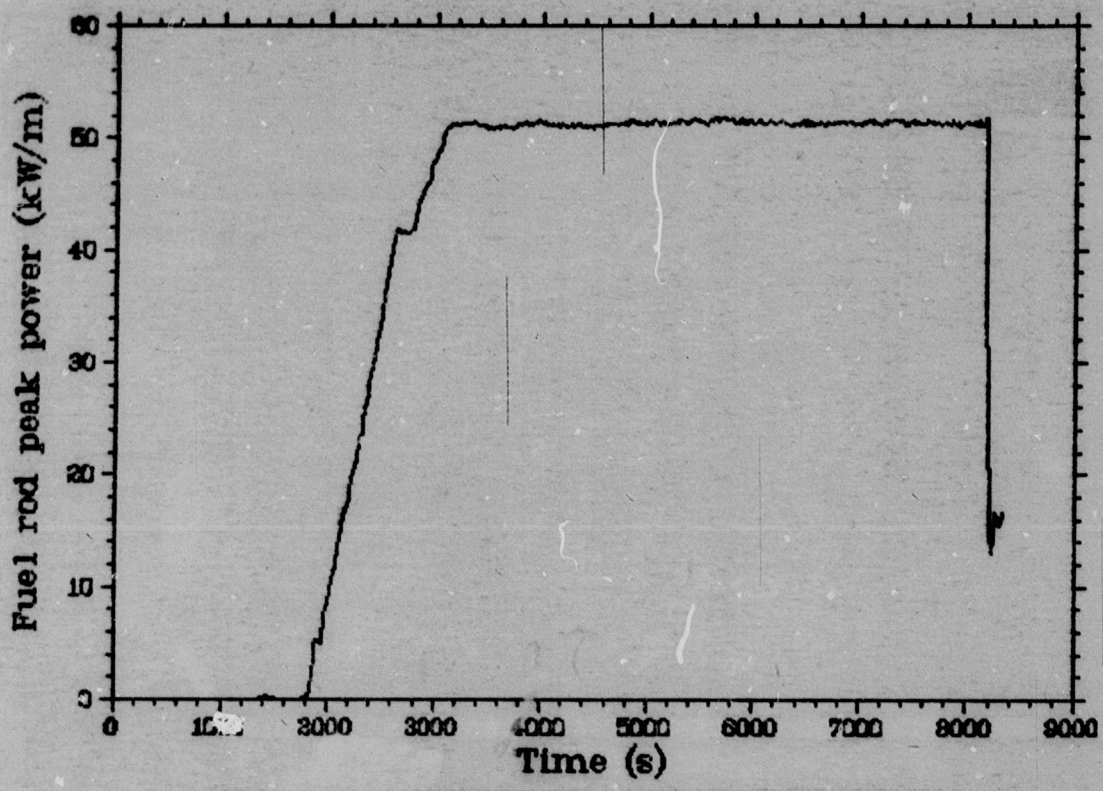


Fig. D-24 Fuel rod peak power history during Test PCM-3 DNB Cycle 1.

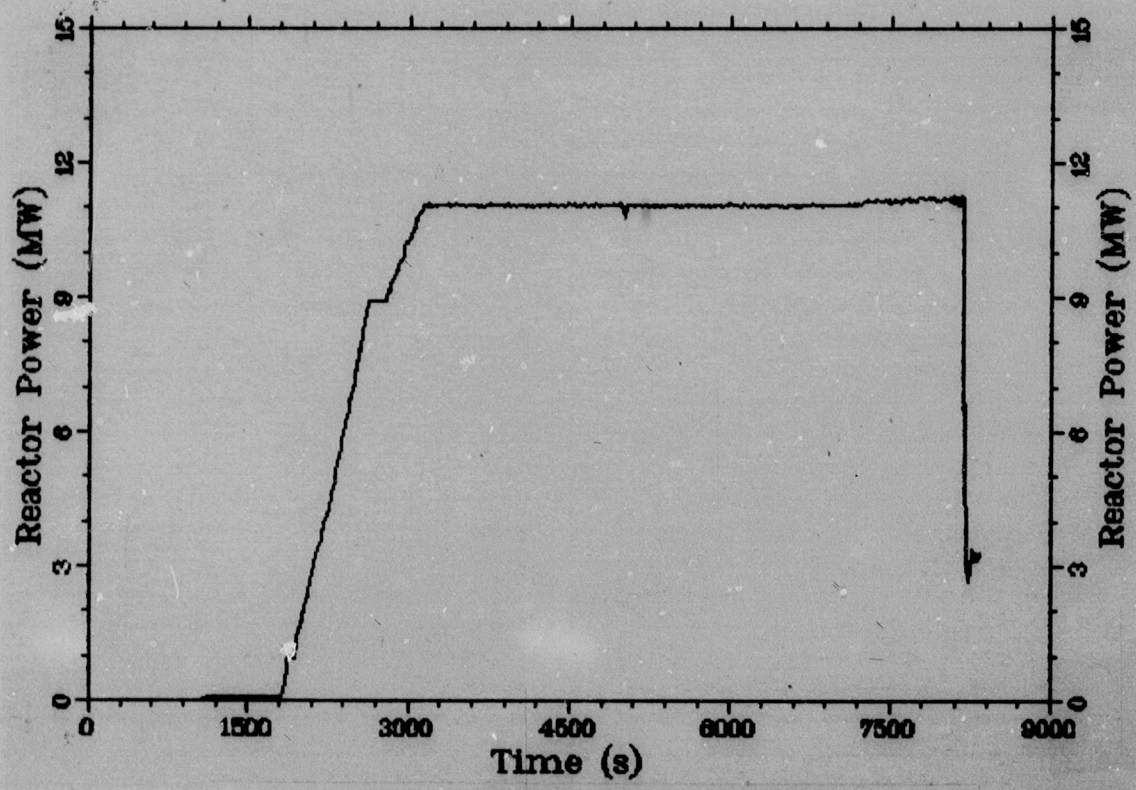


Fig. D-25 PBF core power history during Test PCM-3 DNB Cycle 1.

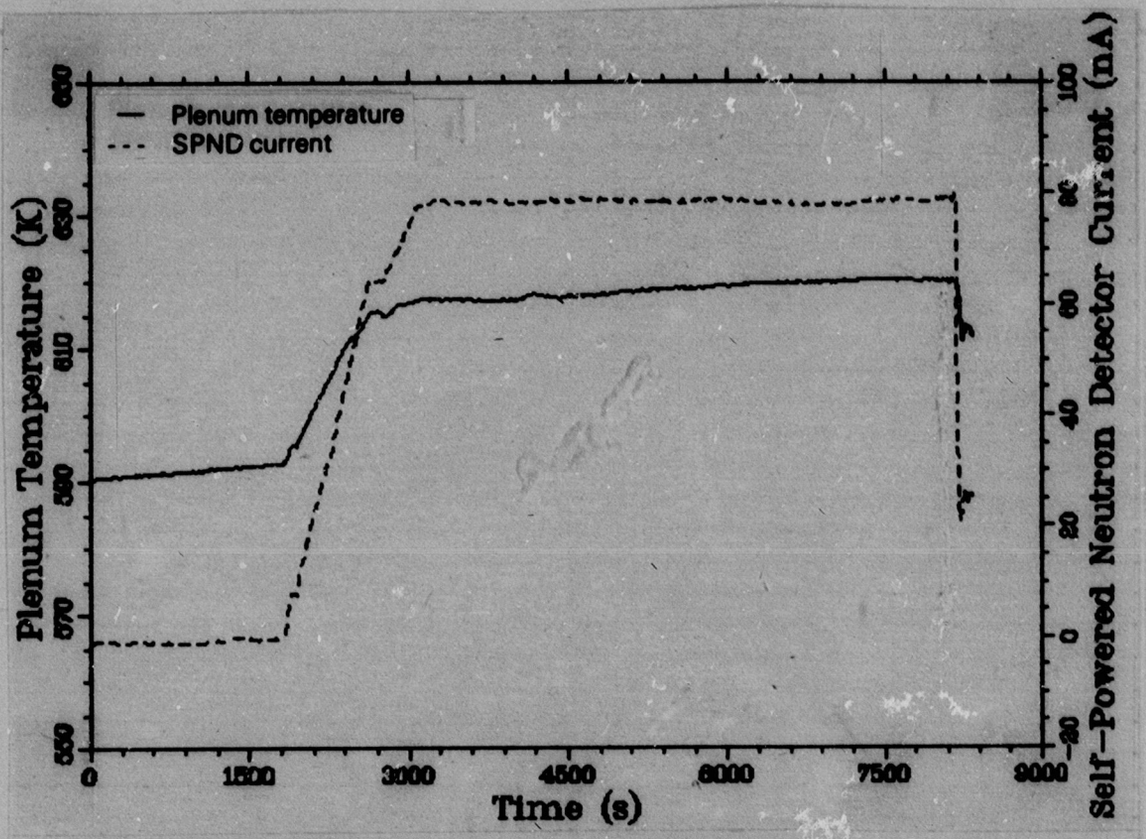


Fig. D-26 Plenum temperature and SPND current at 0.31-m elevation histories during Test PCM-3 DNB Cycle 1.

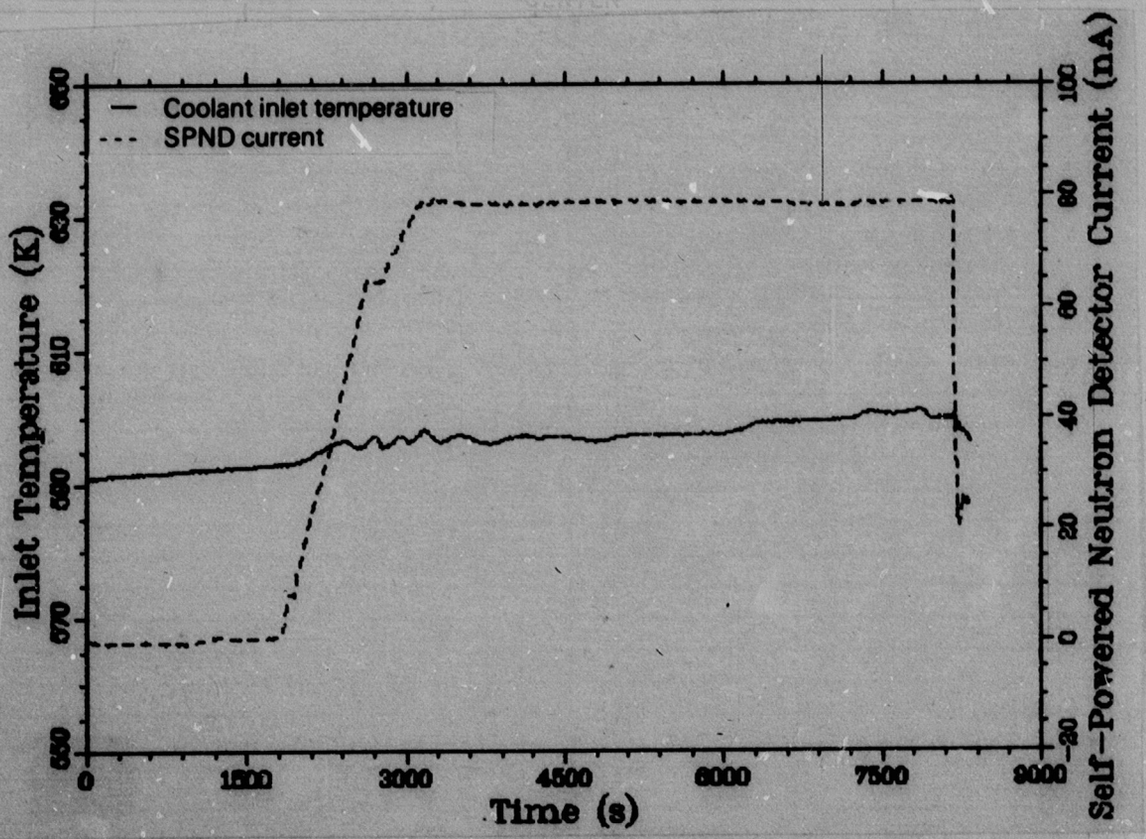


Fig. D-27 Coolant inlet temperature No. 1 and SPND current at 0.47-m elevation histories during Test PCM-3 DNB Cycle 1.

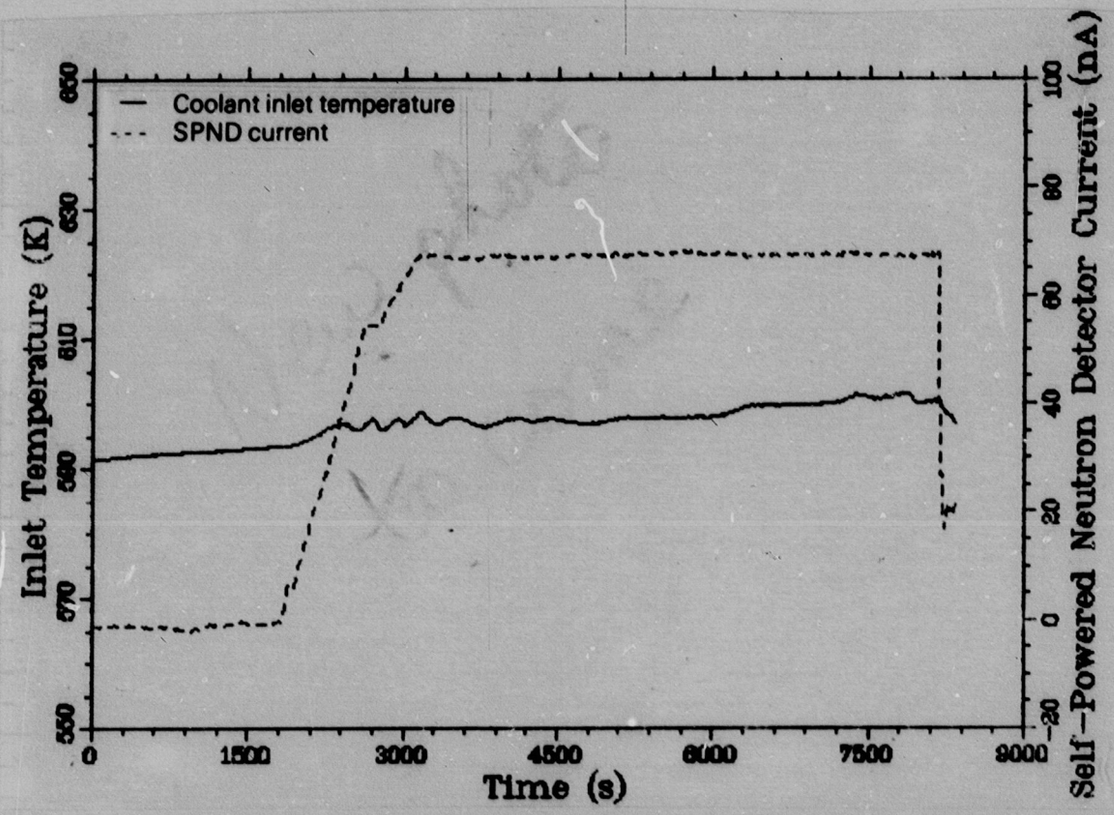


Fig. D-28 Coolant inlet temperature No. 2 and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 1.

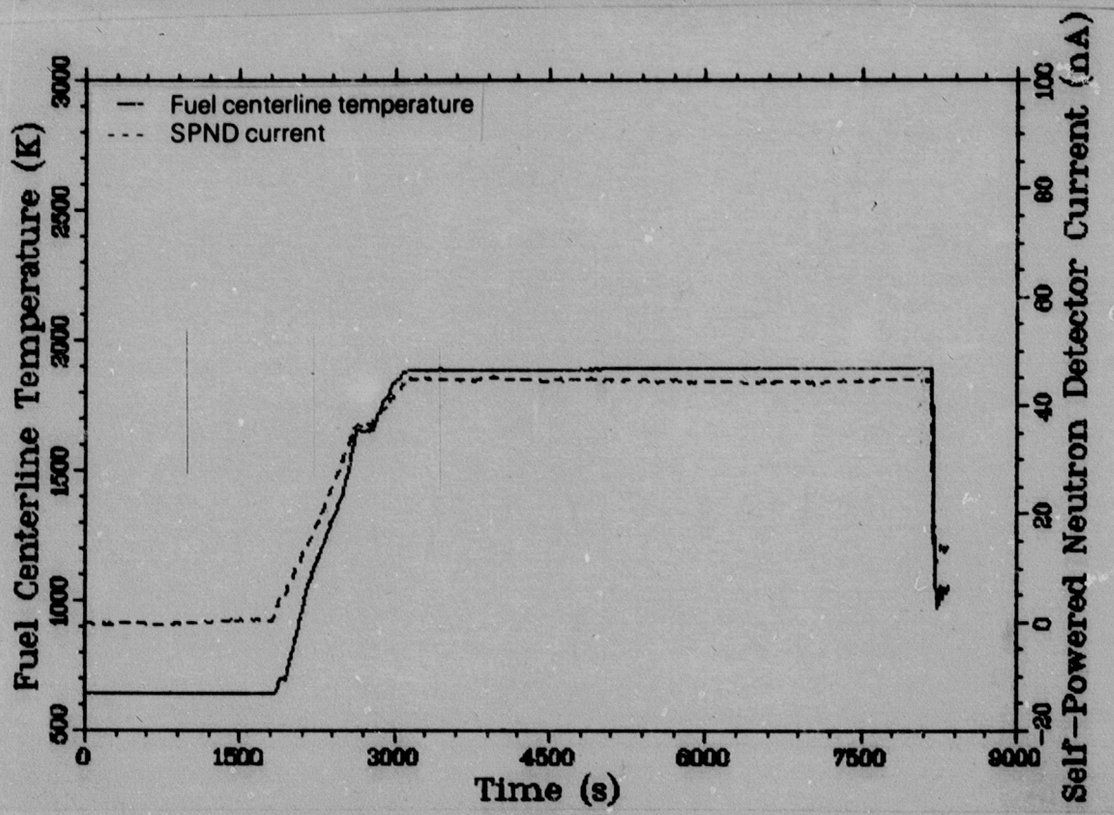


Fig. D-29 Rod UTA-0011 fuel centerline temperature and SPND current at 0.78-m elevation histories during Test PCM-3 DNB Cycle 1.

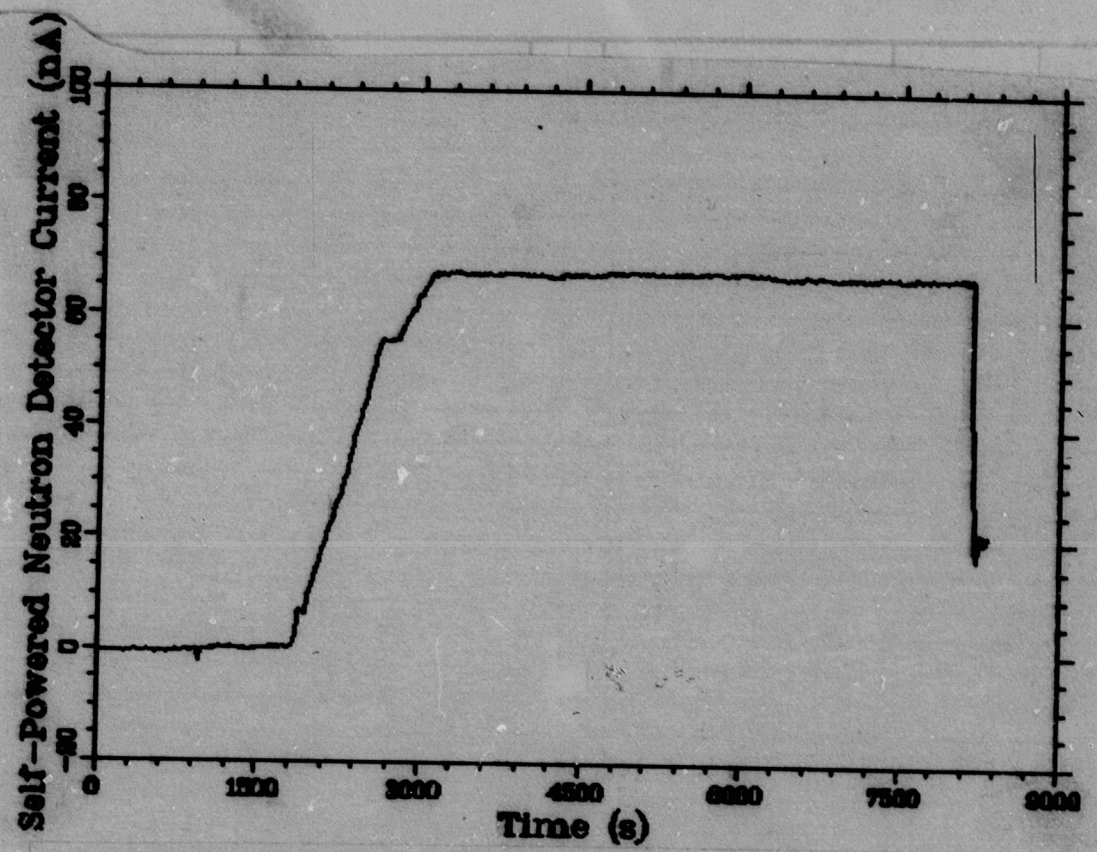


Fig. D-30 Rod UTA-0013 SPND current at 0.63-m elevation history during Test PCM-3 DNB Cycle 1.

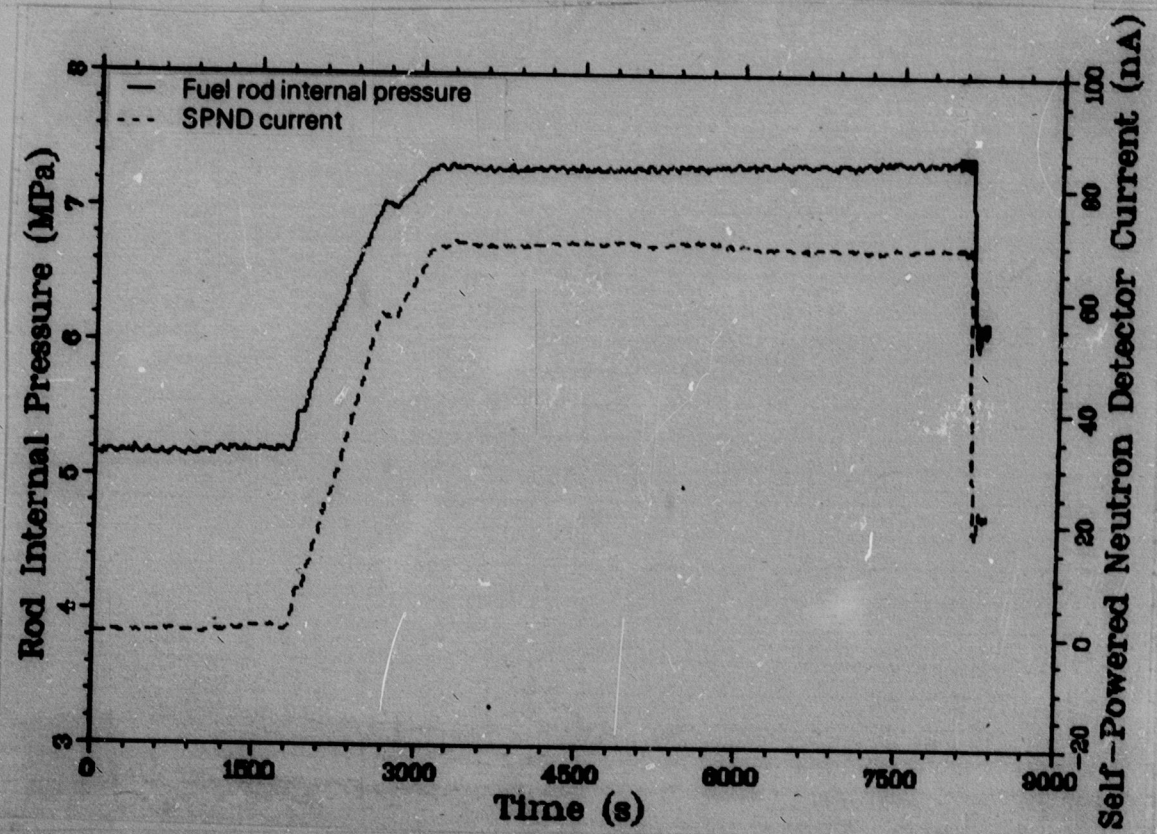


Fig. D-31 Rod UTA-0011 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 1.

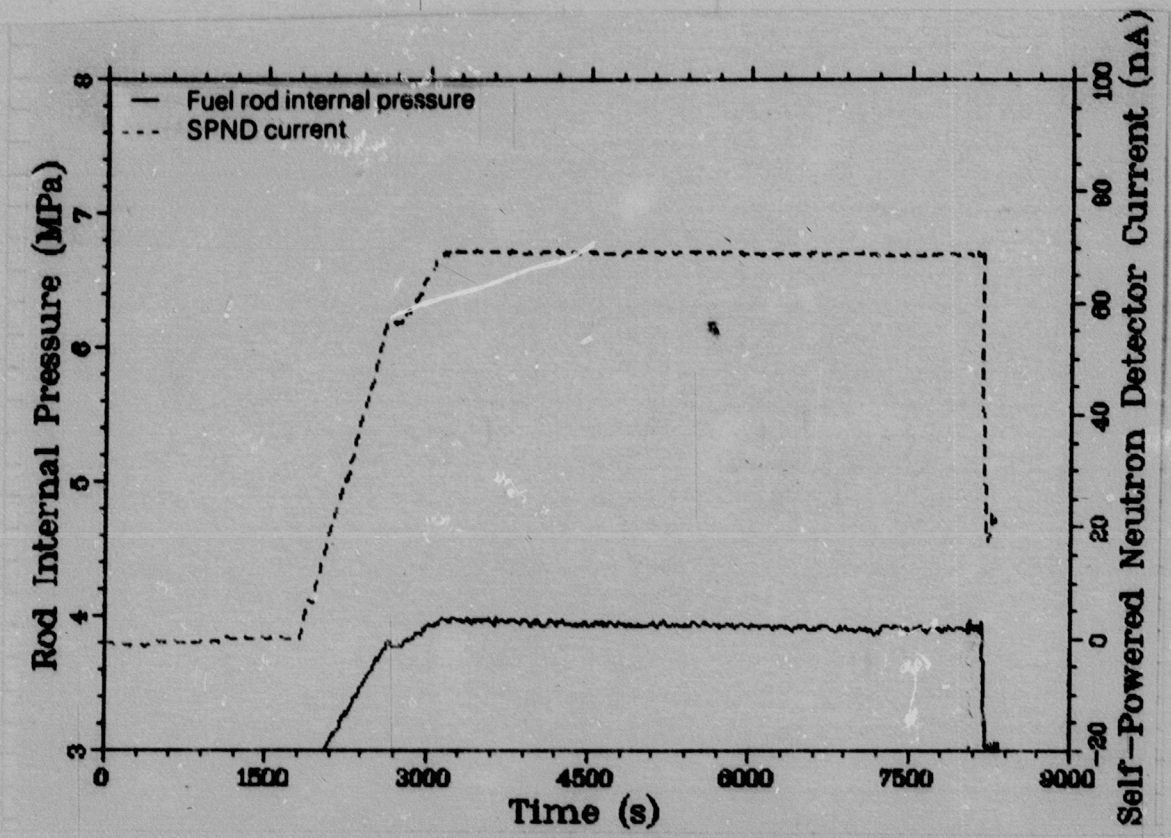


Fig. D-32 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 1.

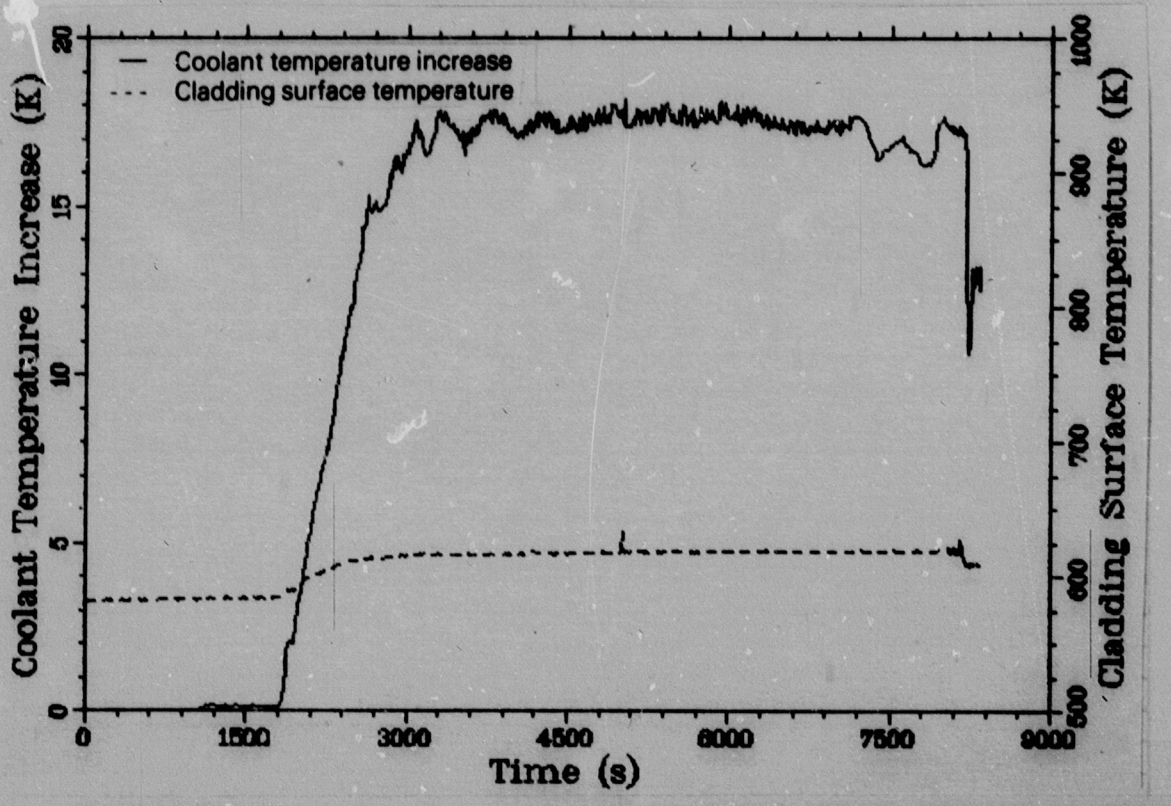


Fig. D-33 Rod UTA-0011 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 1.

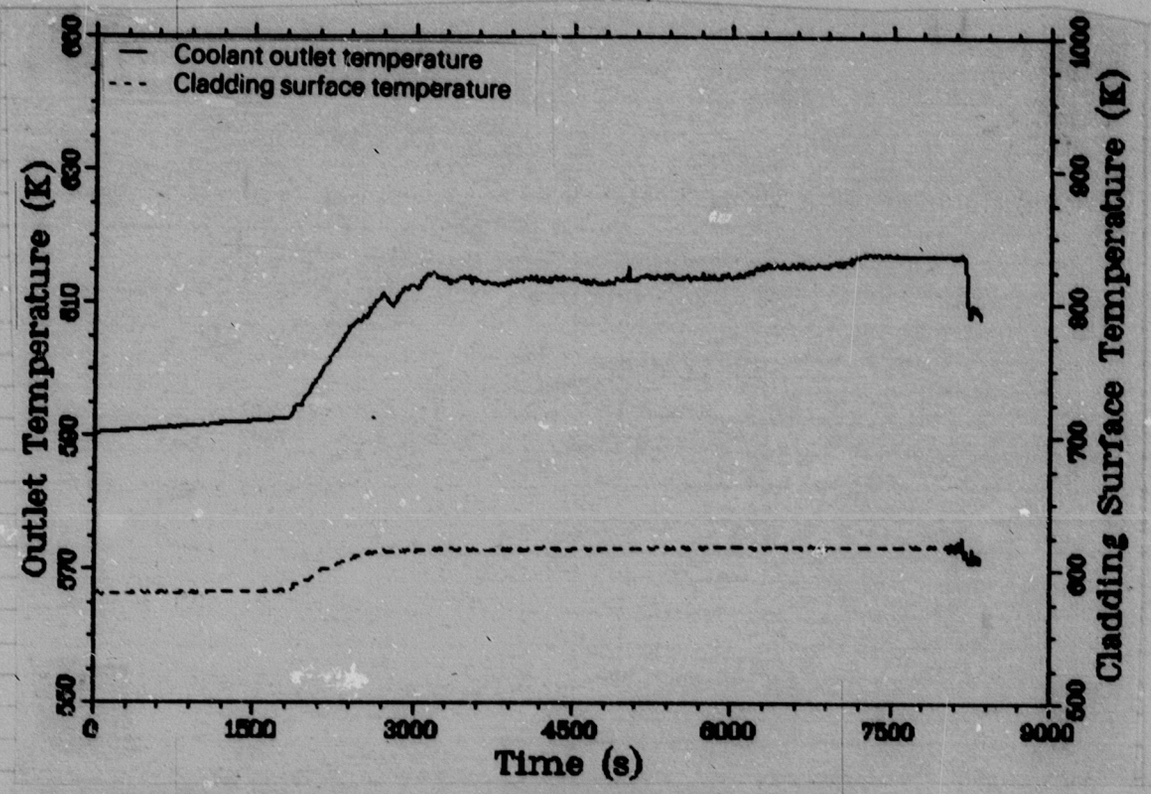


Fig. D-34 Rod UTA-0011 coolant outlet temperature and cladding surface temperature at 0.74-m and 90-degree location histories during Test PCM-3 DNB Cycle 1.

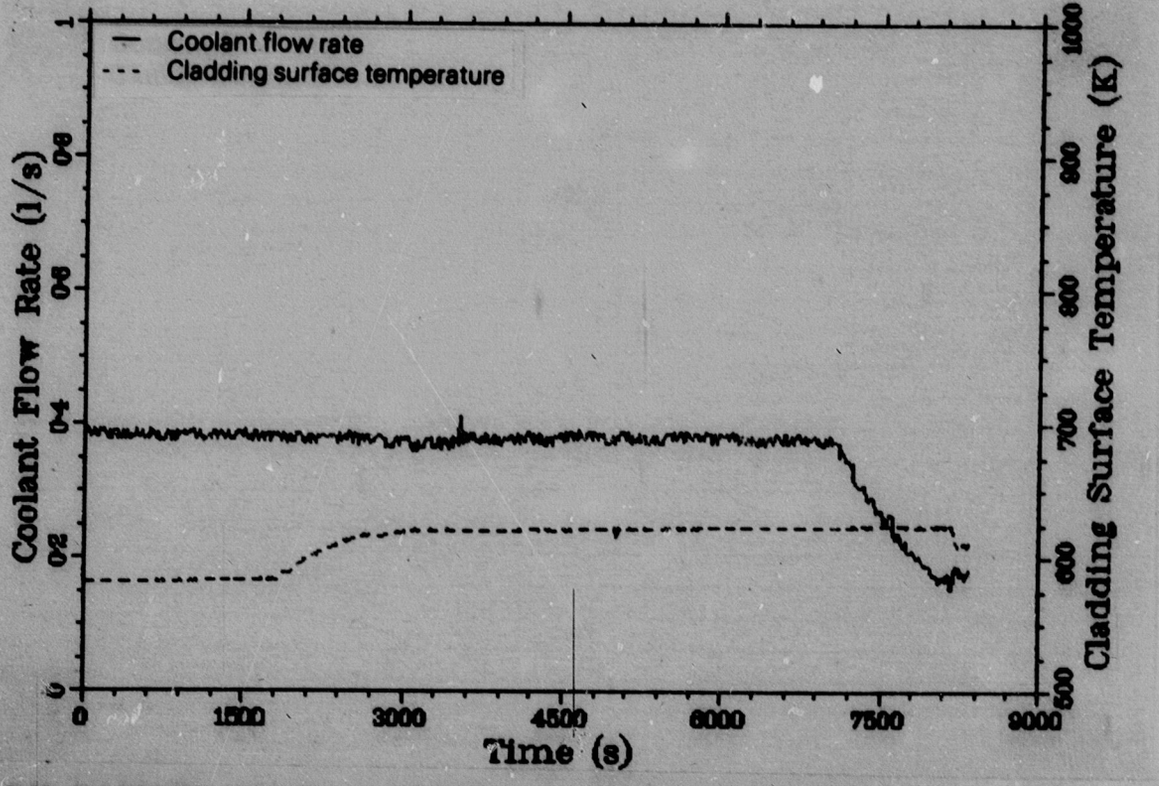


Fig. D-35 Rod UTA-0011 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 1.

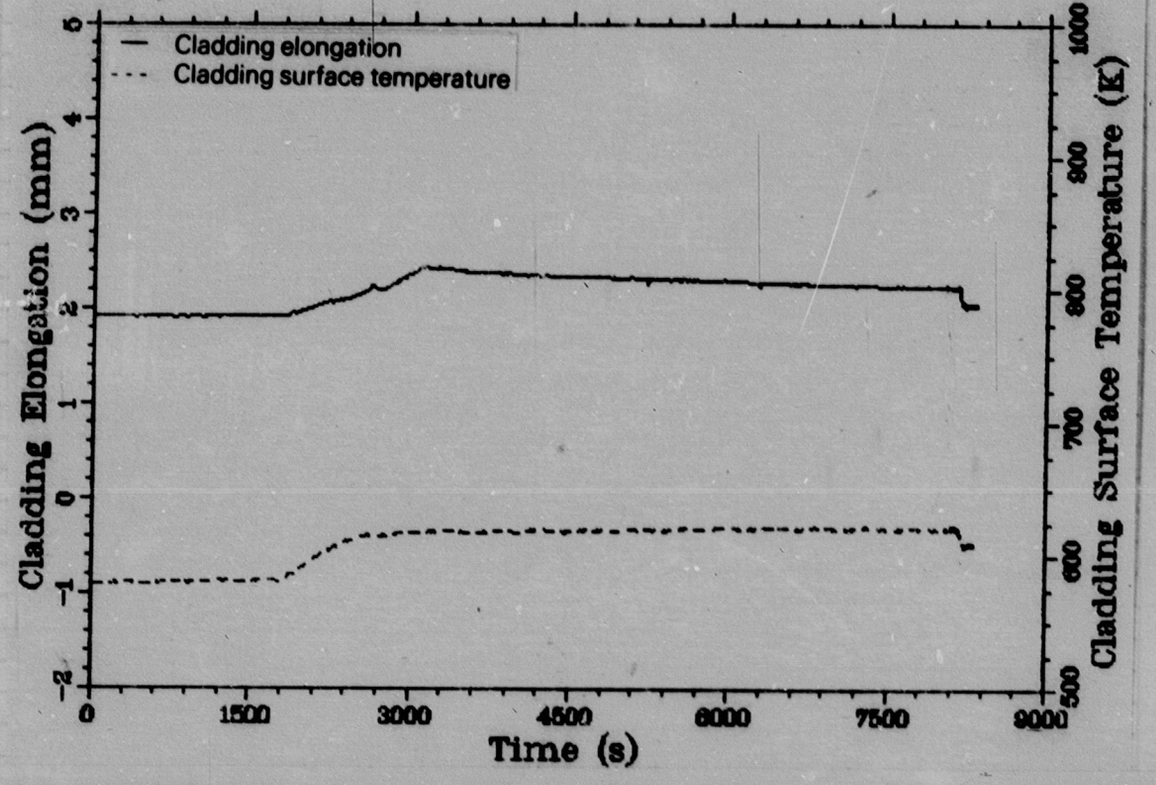


Fig. D-36 Rod UTA-0011 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 1.

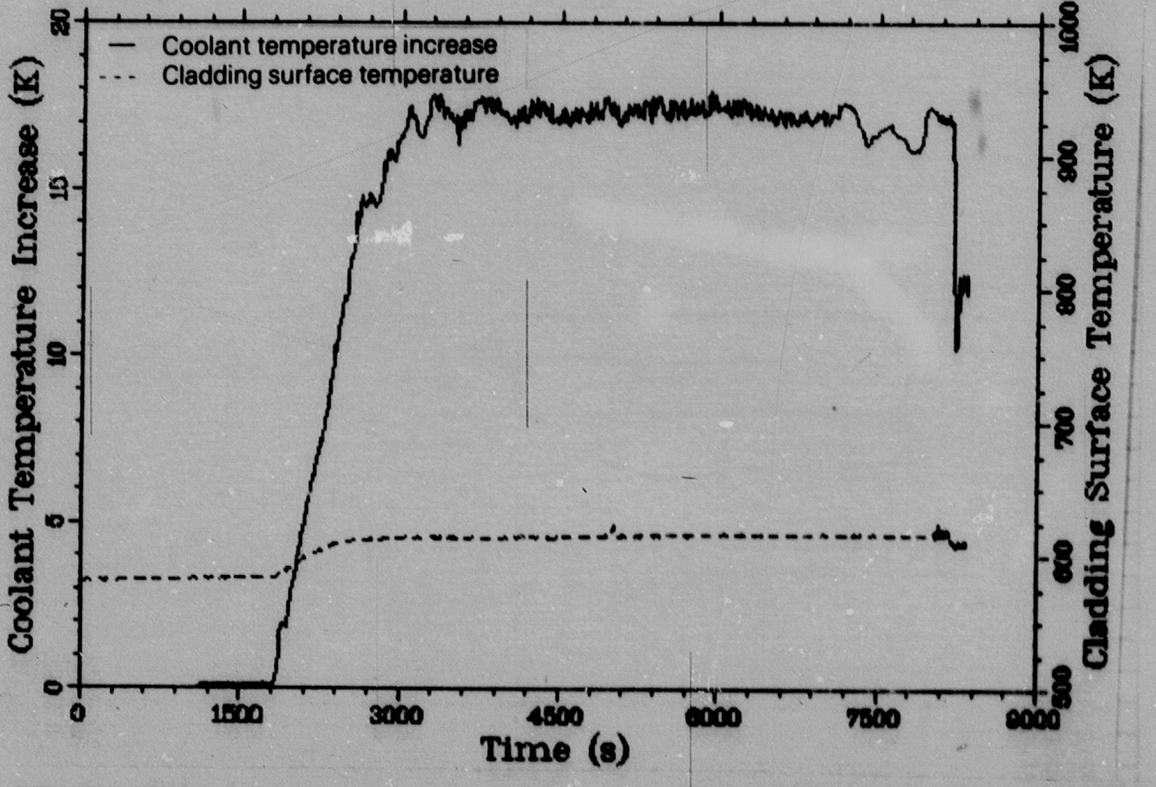


Fig. D-37 Rod A-0021 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 1.

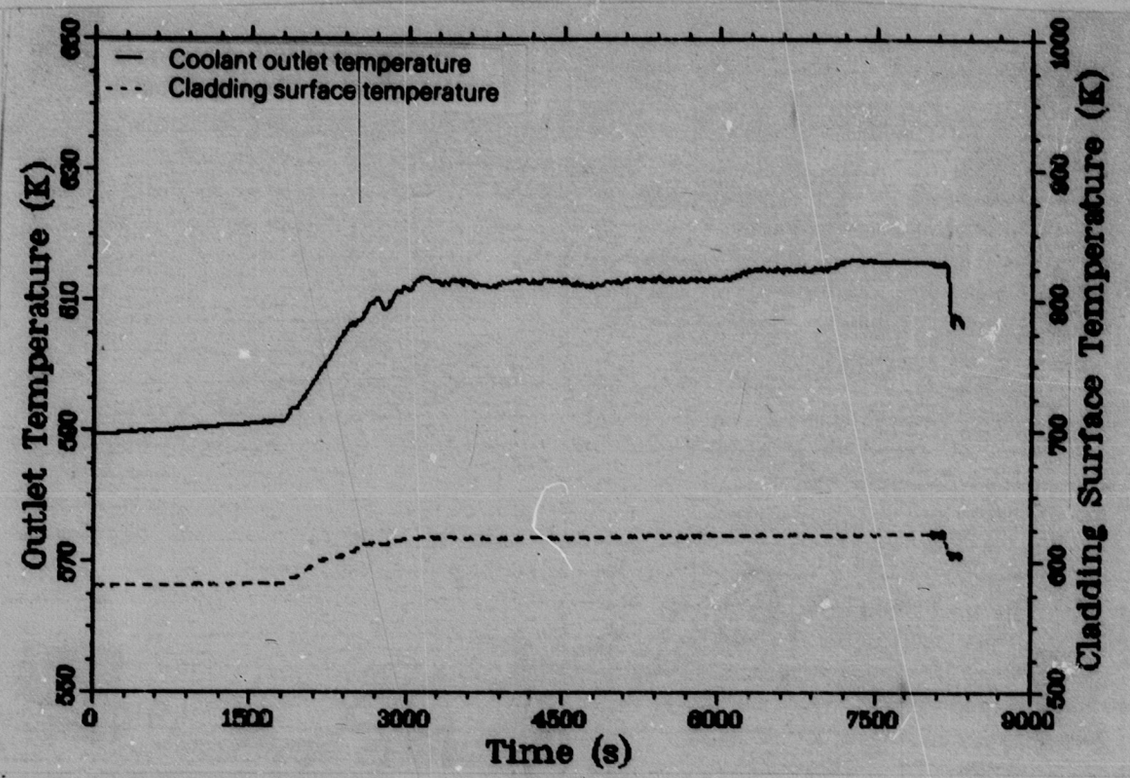


Fig. D-38 Rod A-0021 coolant outlet temperature and cladding surface temperature at 0.69-m and 90-degree location histories during Test PCM-3 DNB Cycle 1.

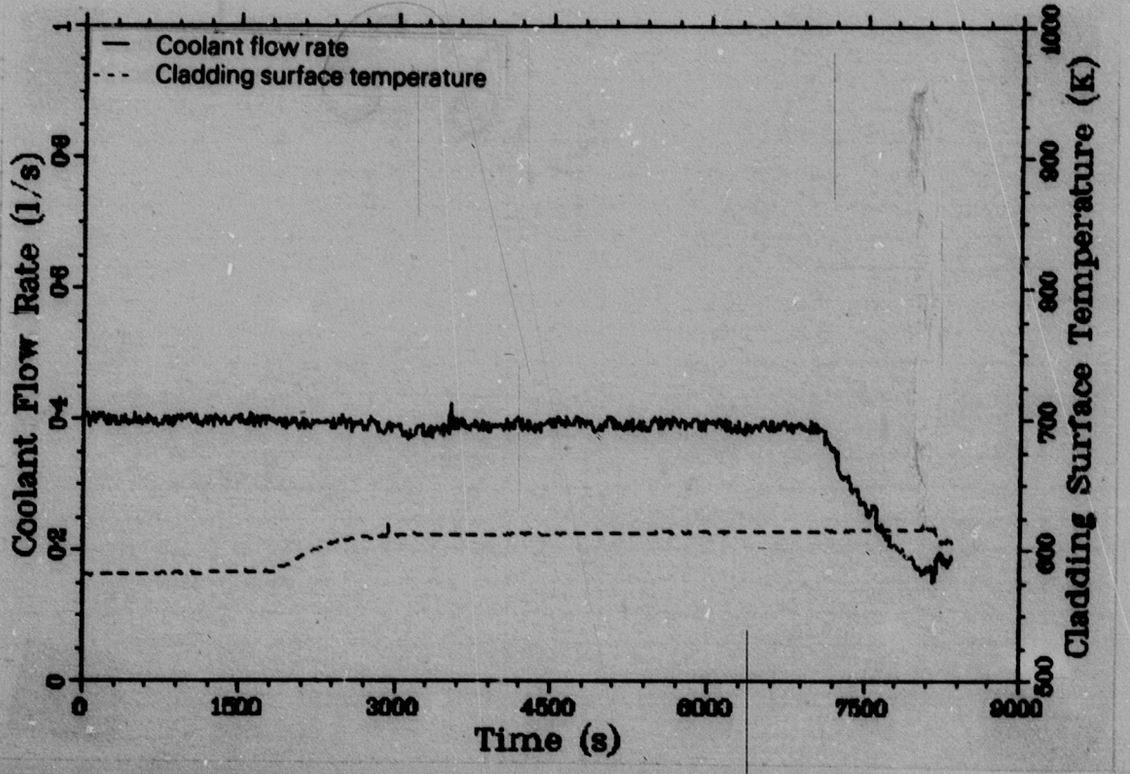


Fig. D-39 Rod A-0021 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 1.

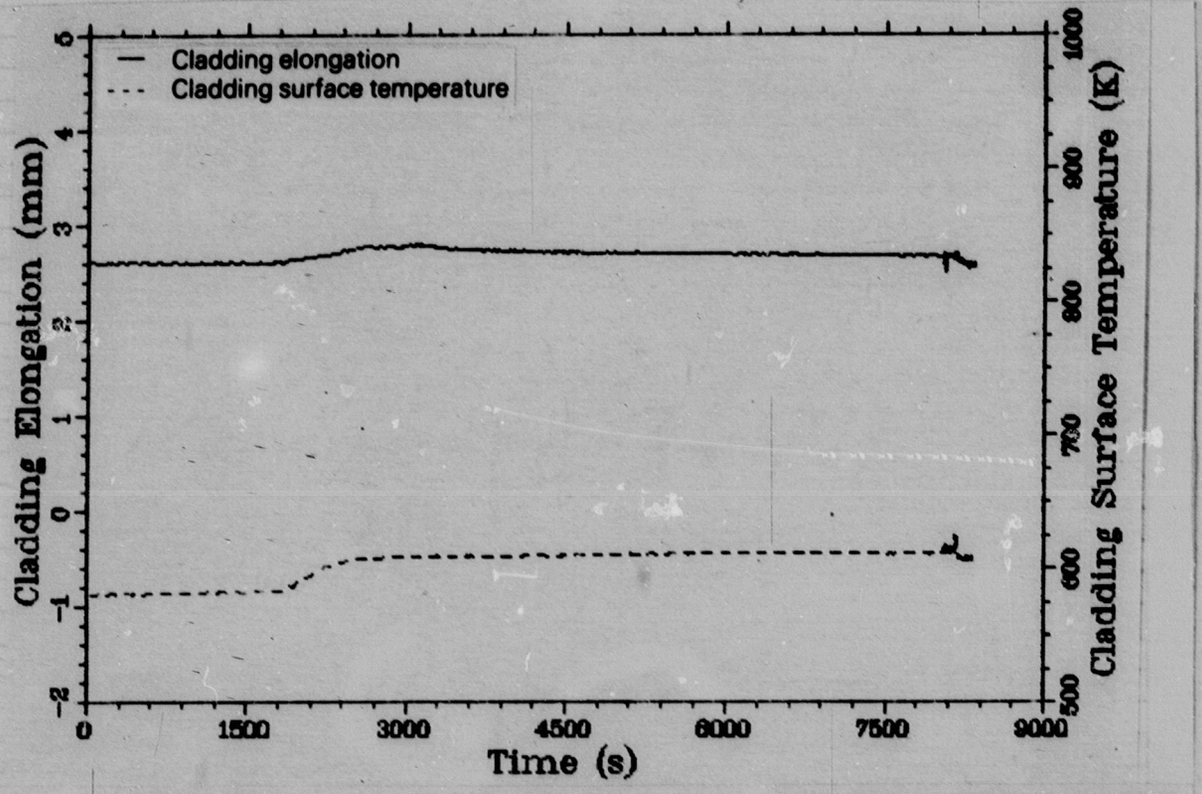


Fig. D-40 Rod A-0021 cladding elongation and cladding surface temperature at 0.89-m and 270-degree location histories during Test PCM-3 DNB Cycle 1.

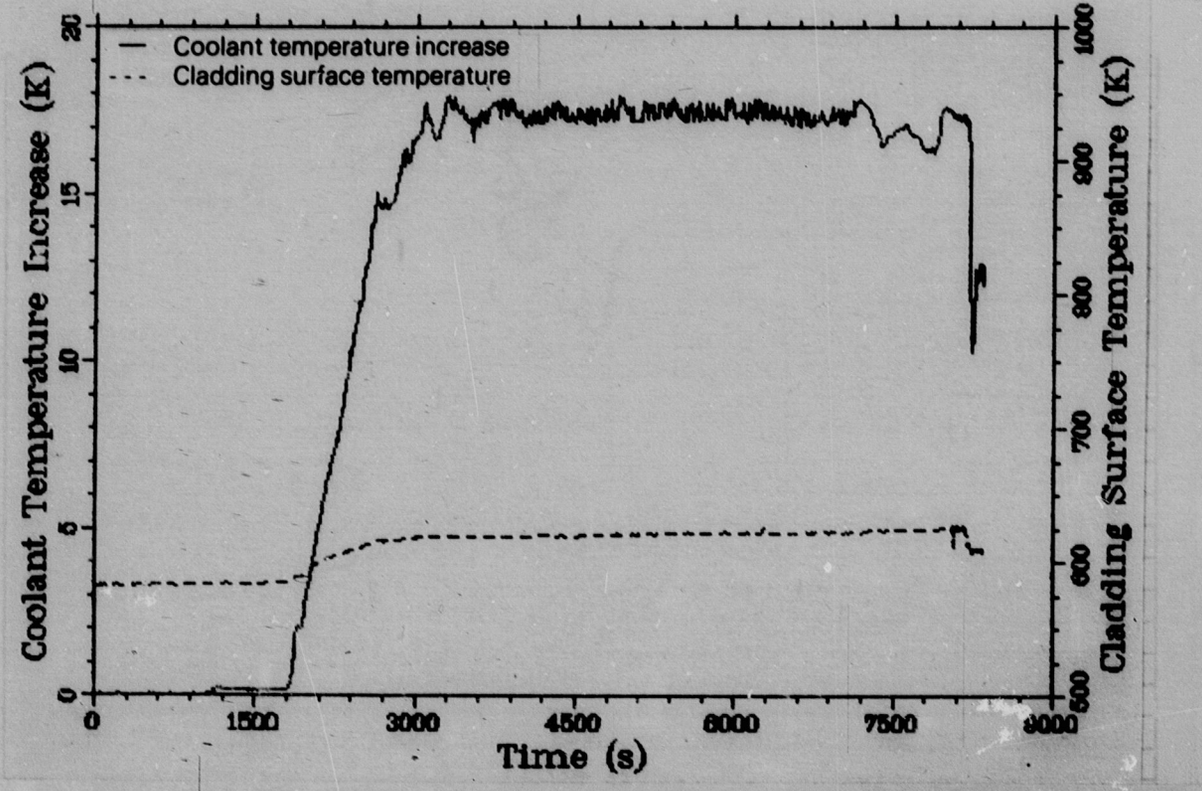


Fig. D-41 Rod UTA-0013 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 1.

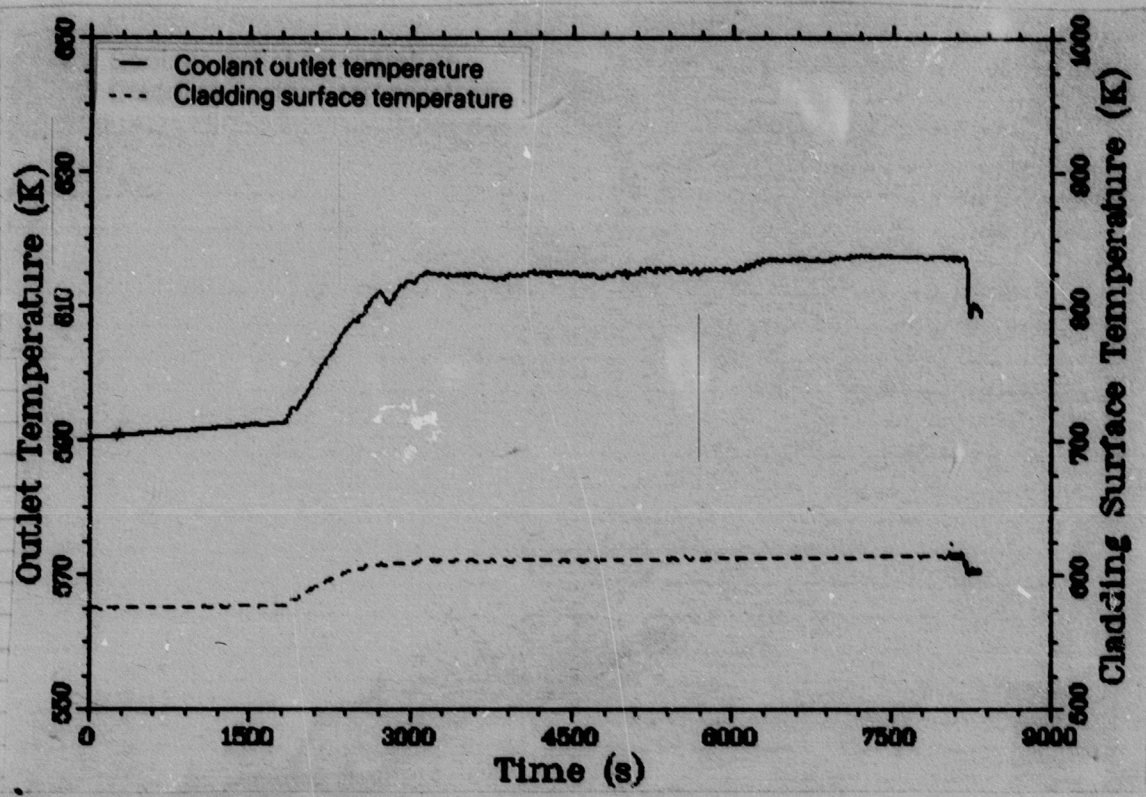


Fig. D-42 Rod UTA-0013 coolant outlet temperature and cladding surface temperature at 0.48-m and 90-degree location histories during Test PCM-3 DNB Cycle 1.

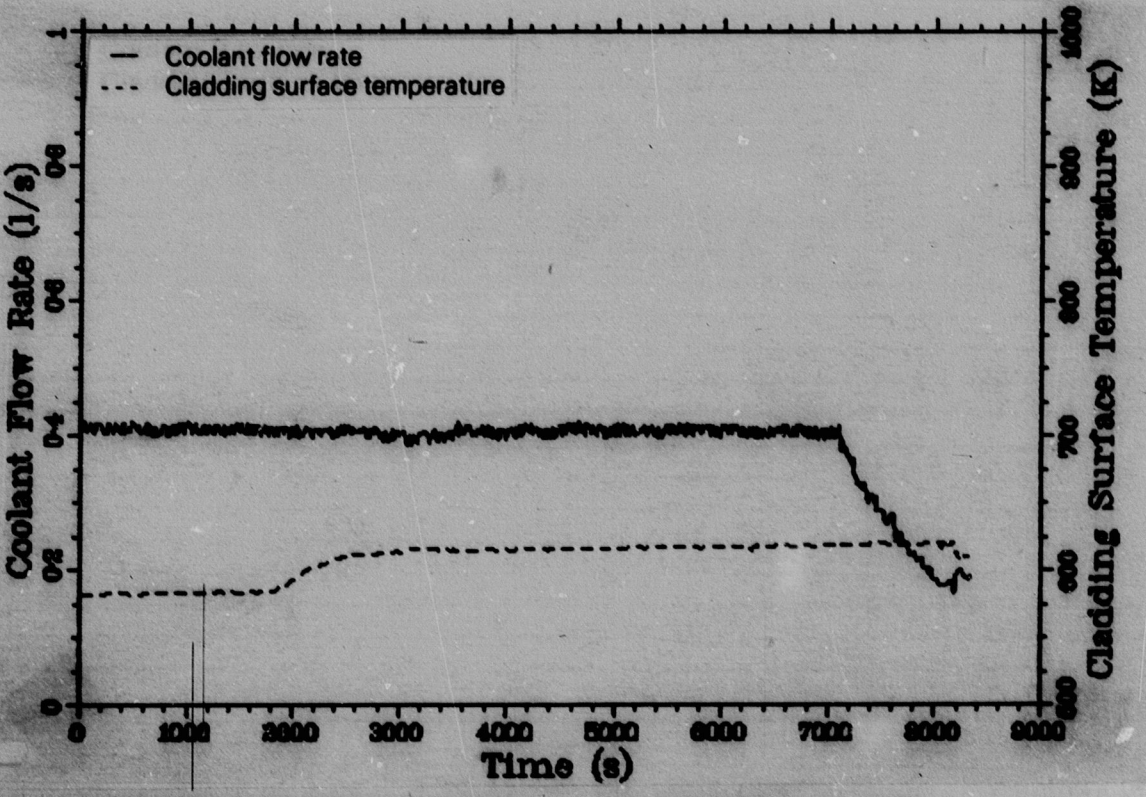


Fig. D-43 Rod UTA-0013 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 1.

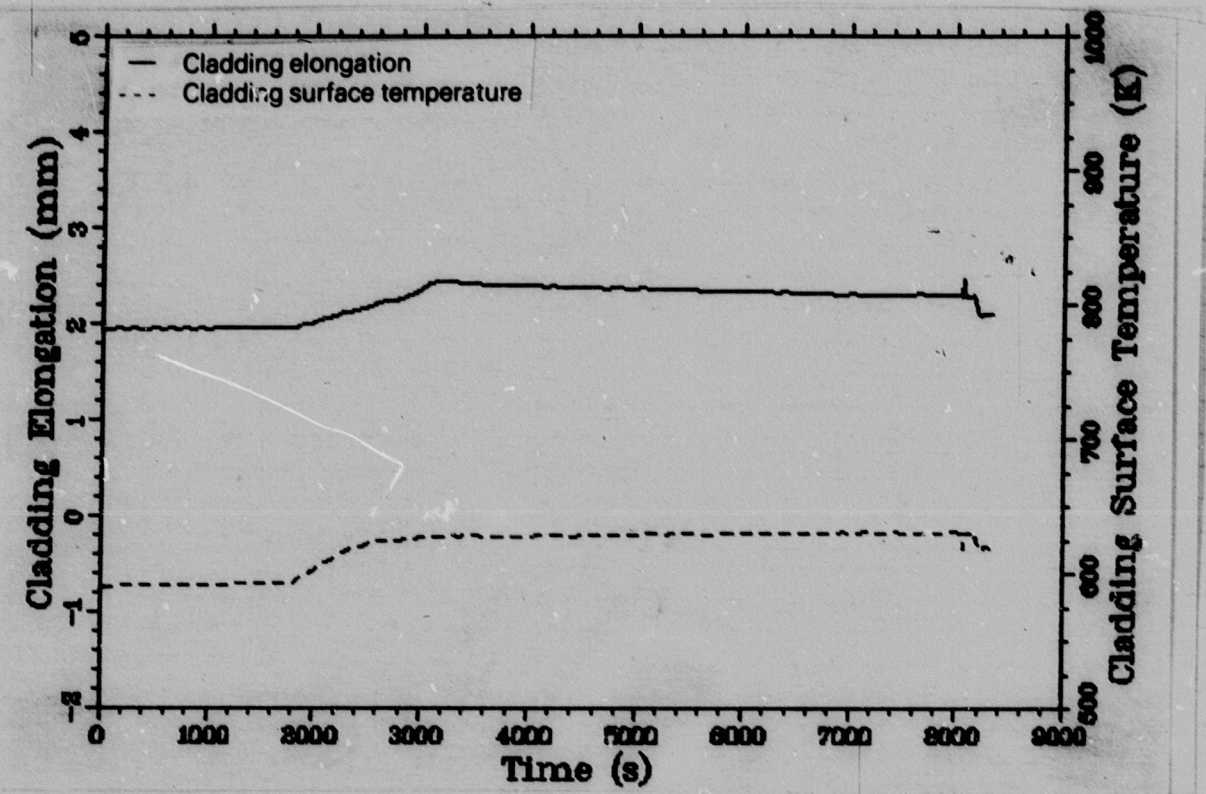


Fig. D-44 Rod UTA-0013 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 1.

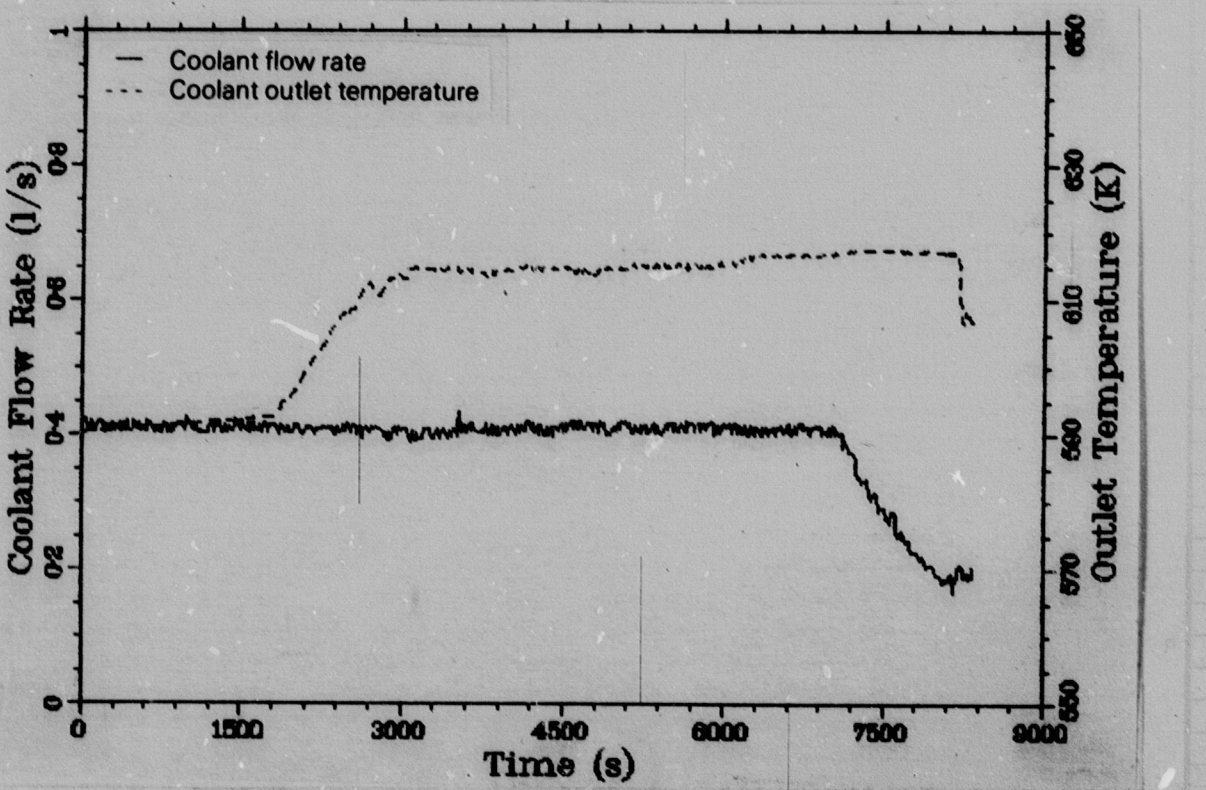


Fig. D-45 Rod A-0015 coolant flow rate and coolant outlet temperature histories during Test PCM-3 DNB Cycle 1.

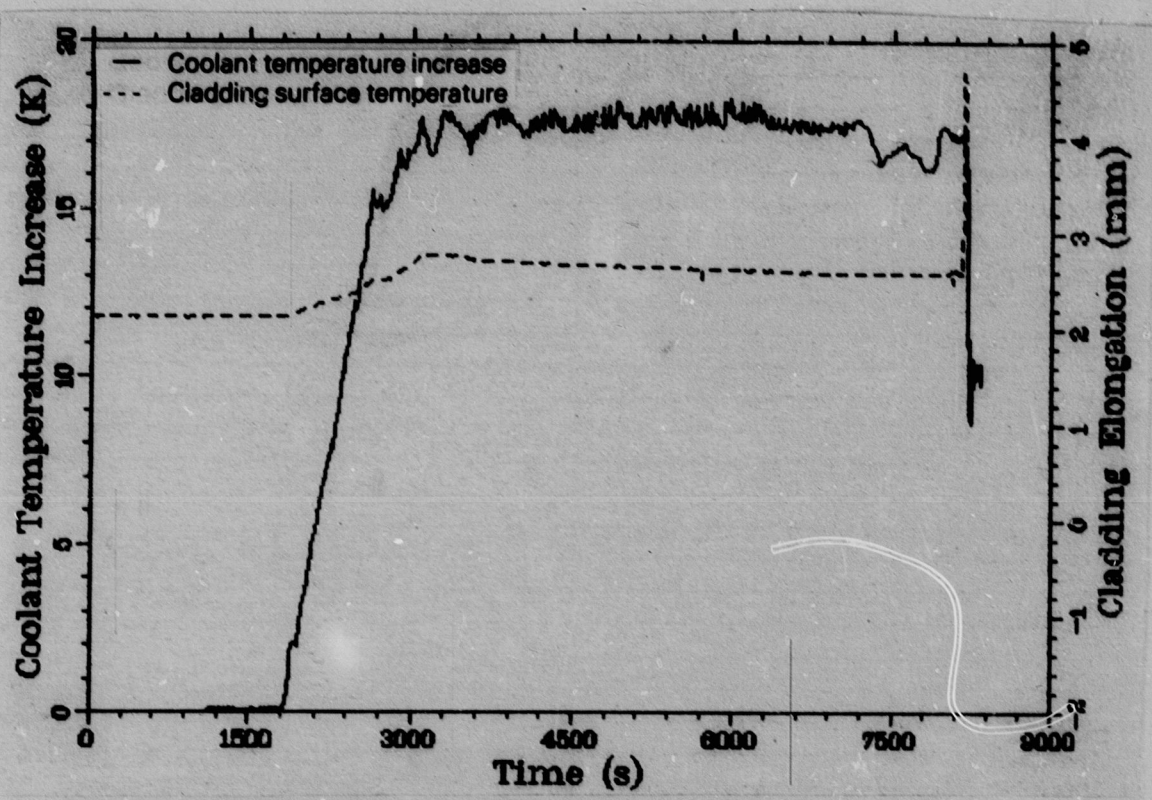


Fig. D-46 Rod A-0015 coolant temperature increase and cladding elongation histories during Test PCM-3 DNB Cycle 1.

DNB CYCLE TWO

Zero time corresponds to Test IRIG time 22:04:00, June 25, 1976.

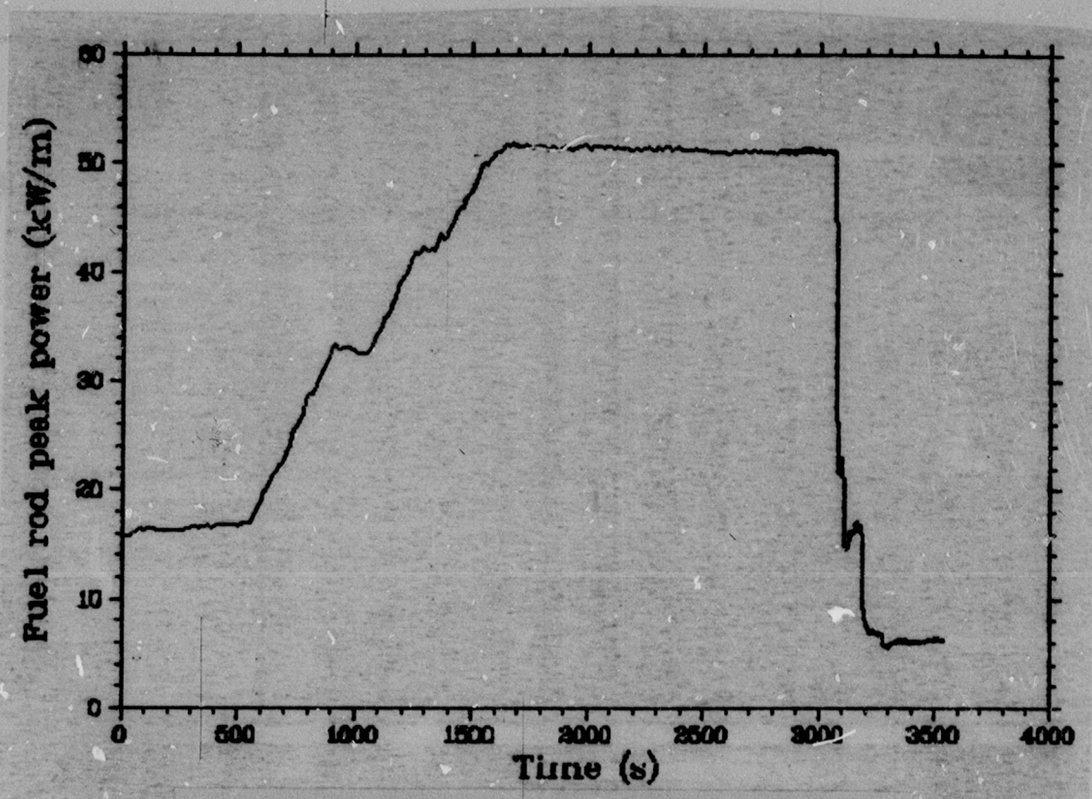


Fig. D-47 Fuel rod peak power history during Test PCM-3 DNB Cycle 2.

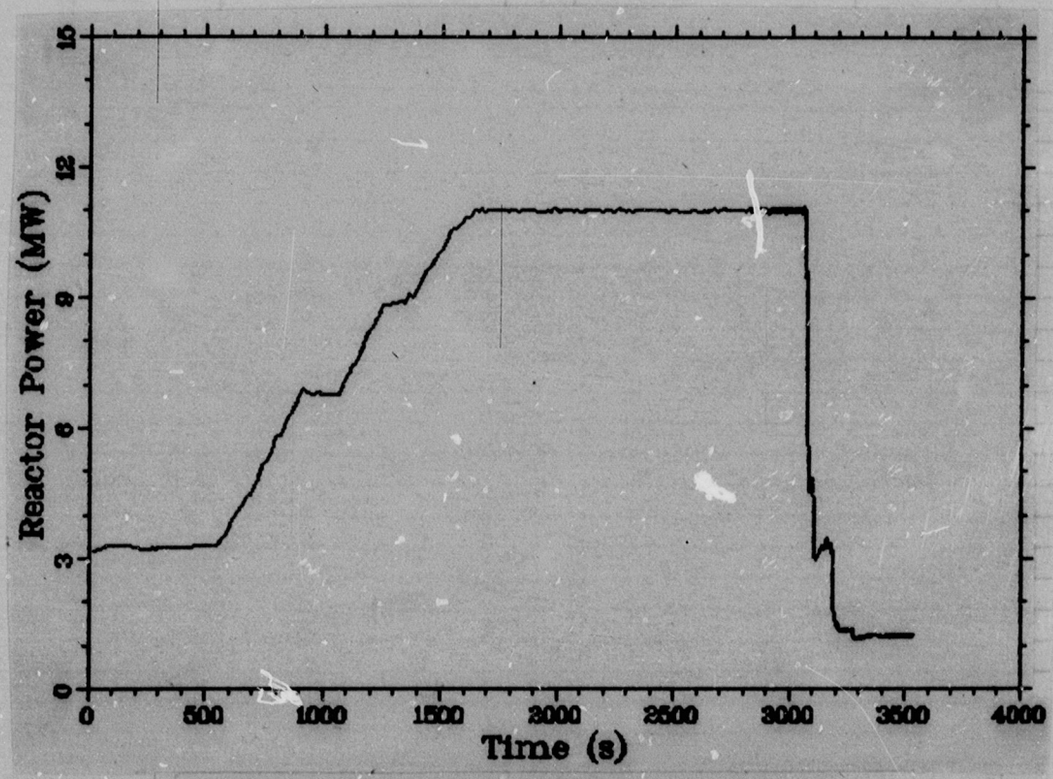


Fig. D-48 PBF core power history during Test PCM-3 DNB Cycle 2.

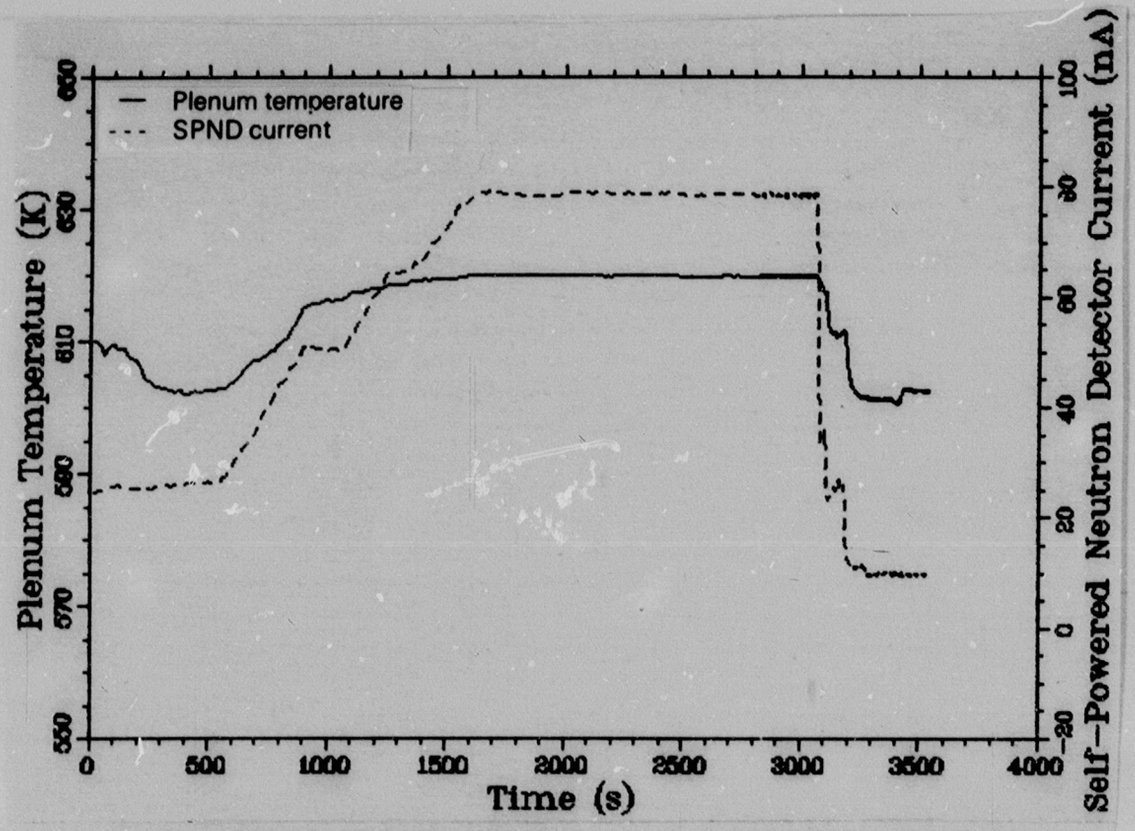


Fig. D-49 Plenum temperature and SPND current at 0.31-m elevation histories during Test PCM-3 DNB Cycle 2.

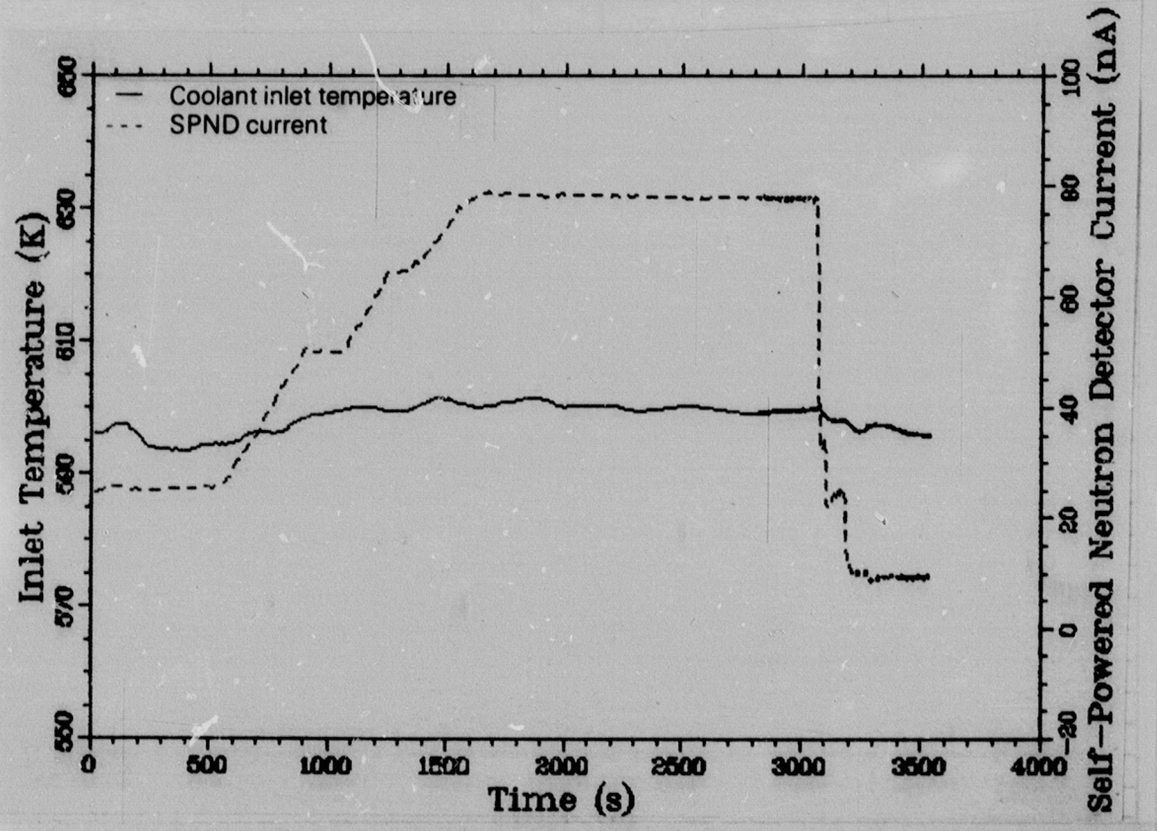


Fig. D-50 Coolant inlet temperature No. 1 and SPND current at 0.47-m elevation histories during Test PCM-3 DNB Cycle 2.

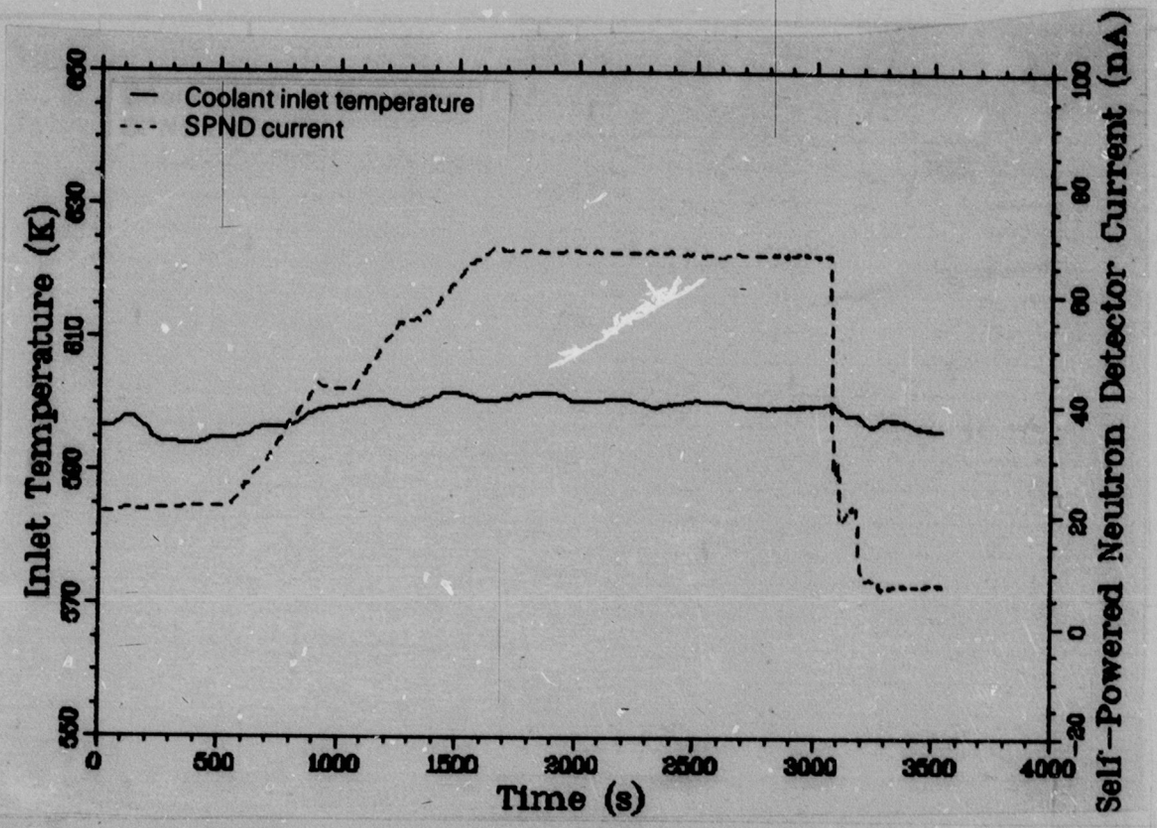


Fig. D-51 Coolant inlet temperature No. 2 and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 2.

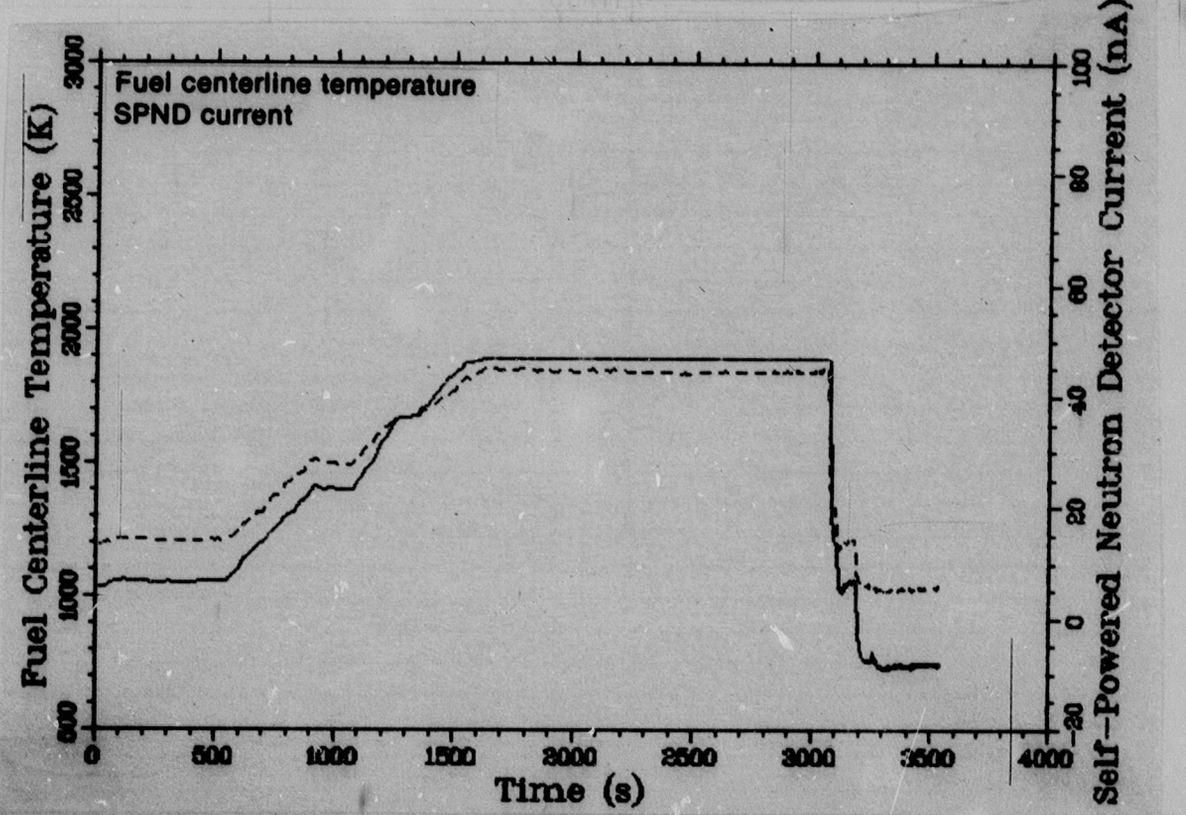


Fig. D-52 Rod UTA-0011 fuel centerline temperature and SPND current at 0.78-m elevation histories during Test PCM-3 DNB Cycle 2.

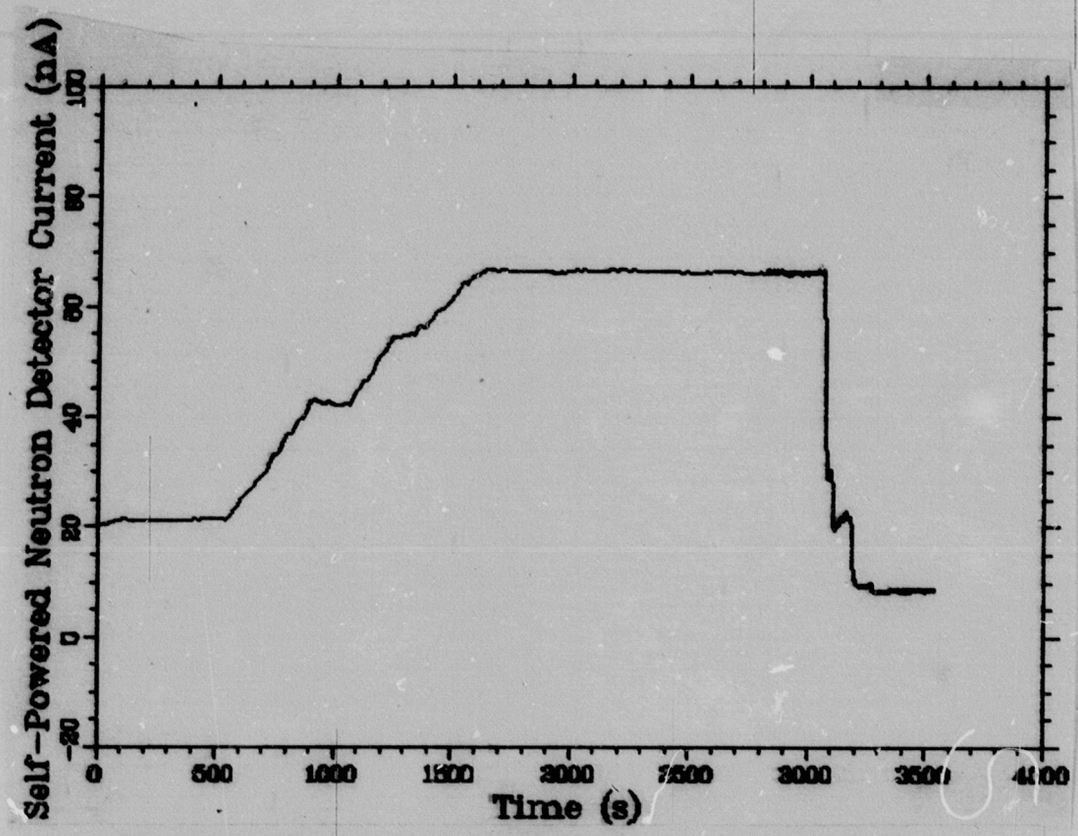


Fig. D-53 Rod UTA-0013 SPND current at 0.63-m elevation history during Test PCM-3 DNB Cycle 2.

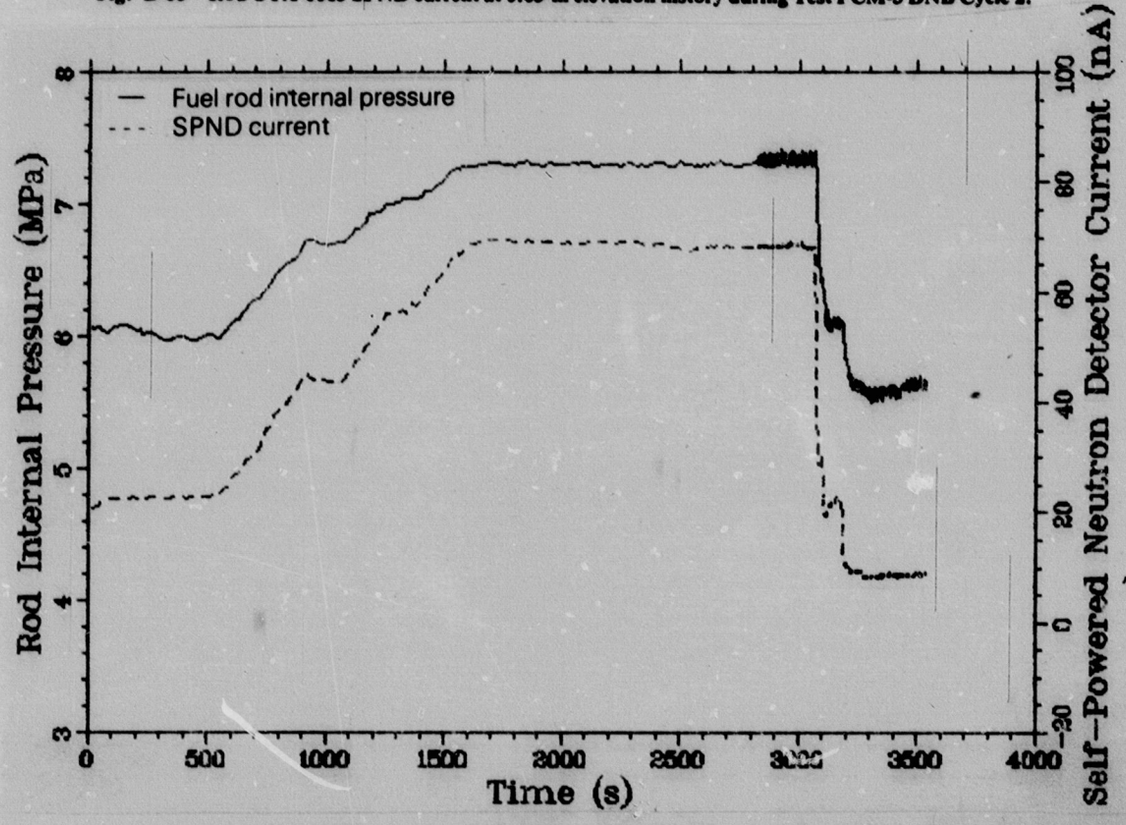


Fig. D-54 Rod UTA-0011 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 2.

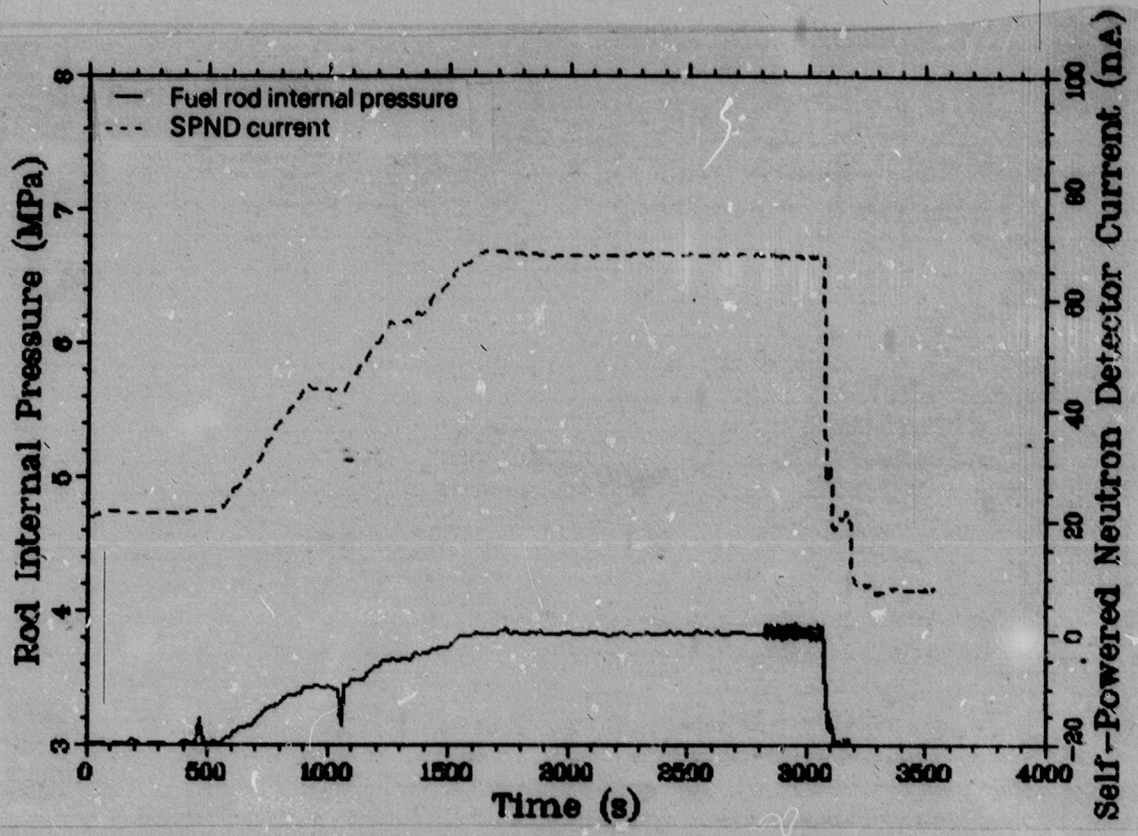


Fig. D-55 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 2.

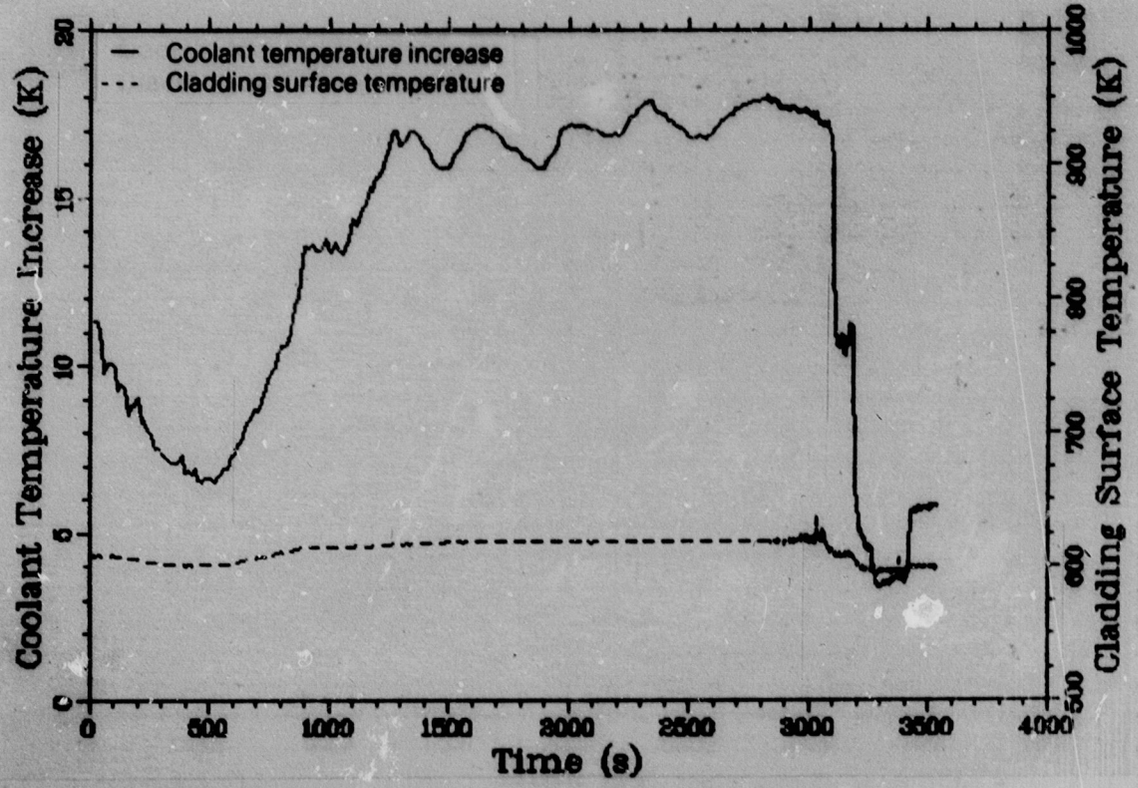


Fig. D-56 Rod UTA-0011 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 2.

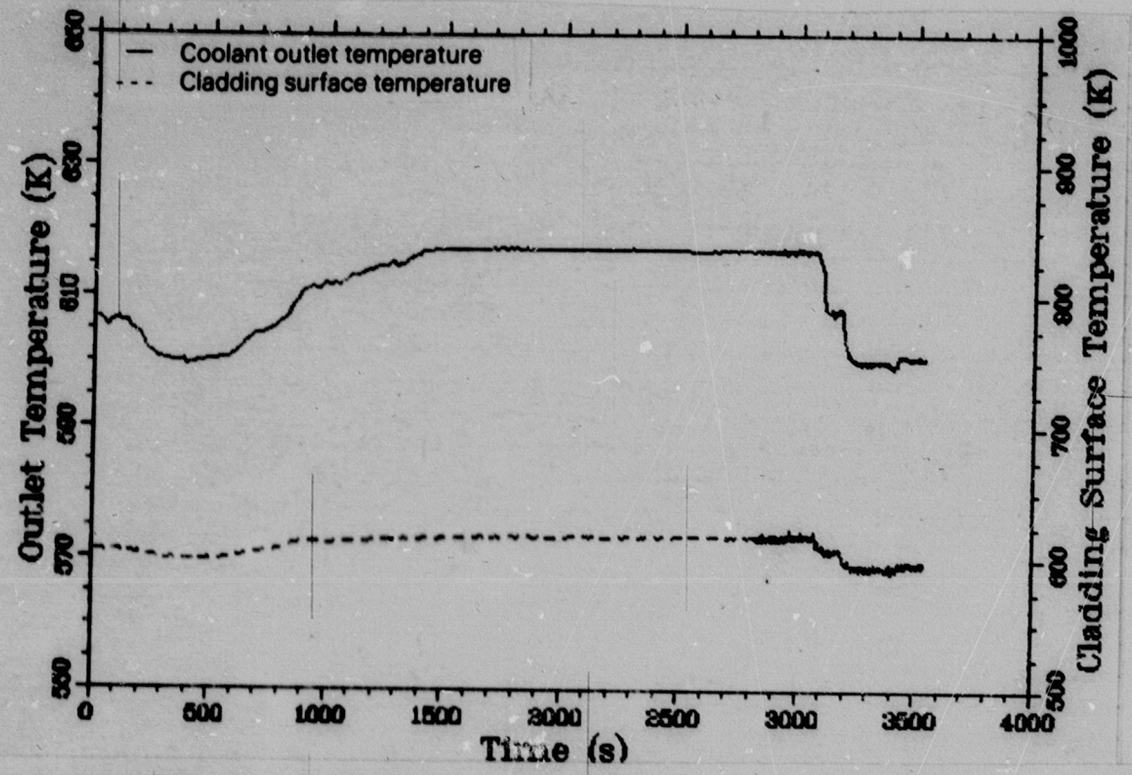


Fig. D-57 Rod UTA-0011 coolant outlet temperature and cladding surface temperature at 0.74-m and 90-degree location histories during Test PCM-3 DNB Cycle 2.

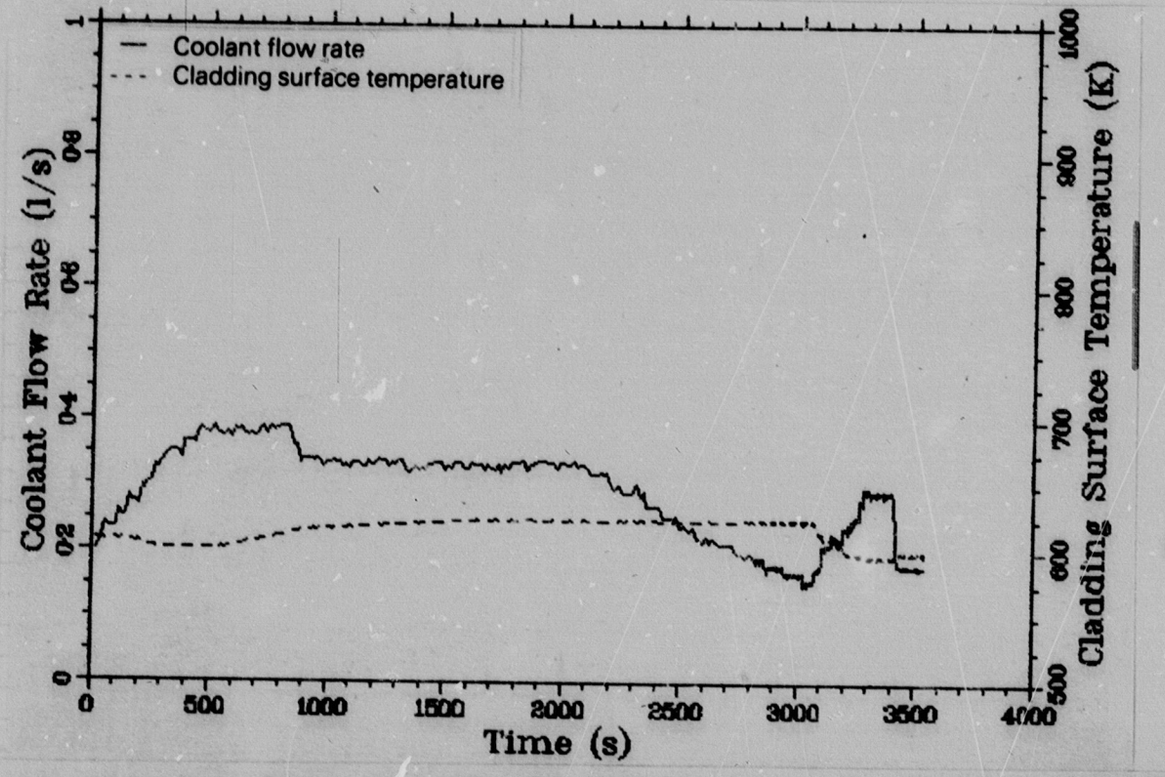


Fig. D-58 Rod UTA-0011 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 2.

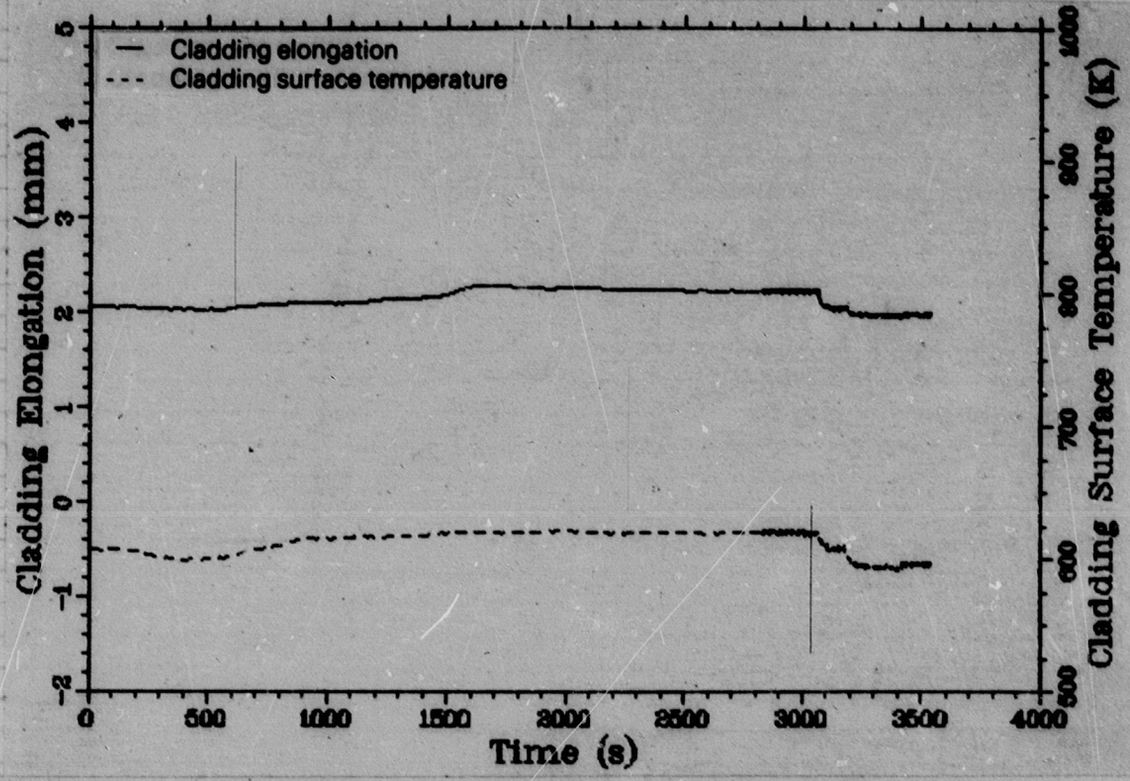


Fig. D-59 Rod UTA-0011 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 2.

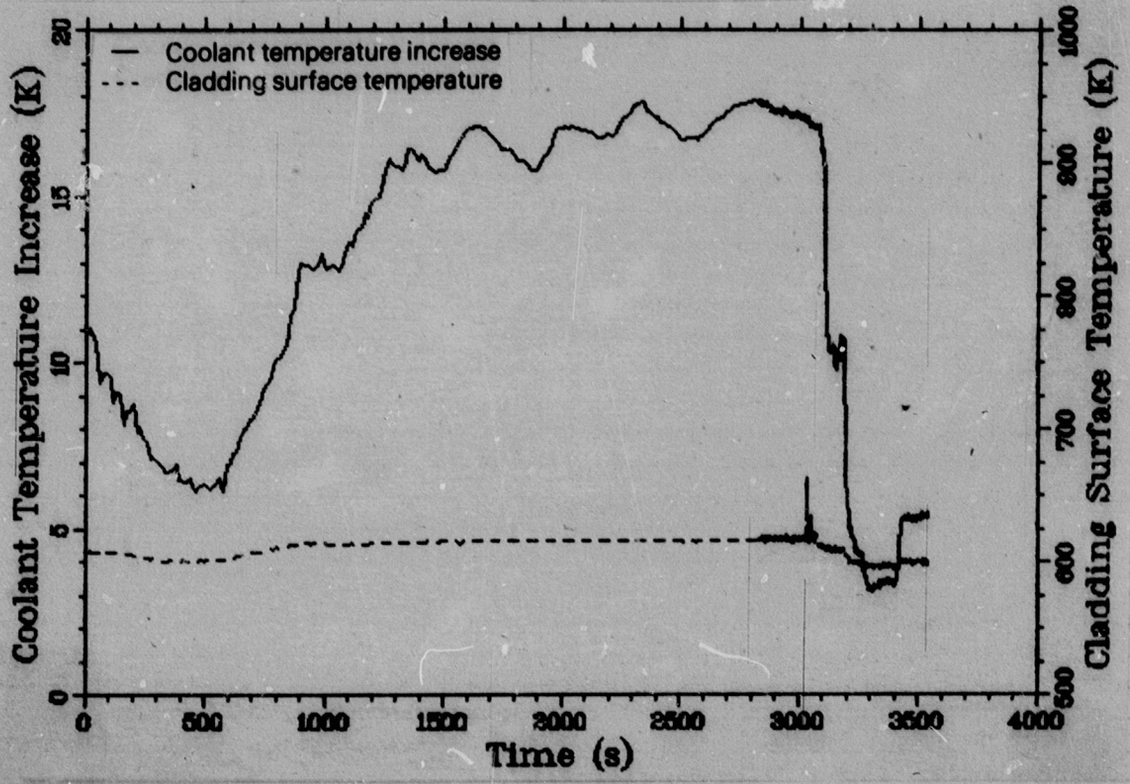


Fig. D-60 Rod A-0021 coolant temperature increase and cladding surface temperature at 0.89-m and 0-degree location histories during Test PCM-3 DNB Cycle 2.

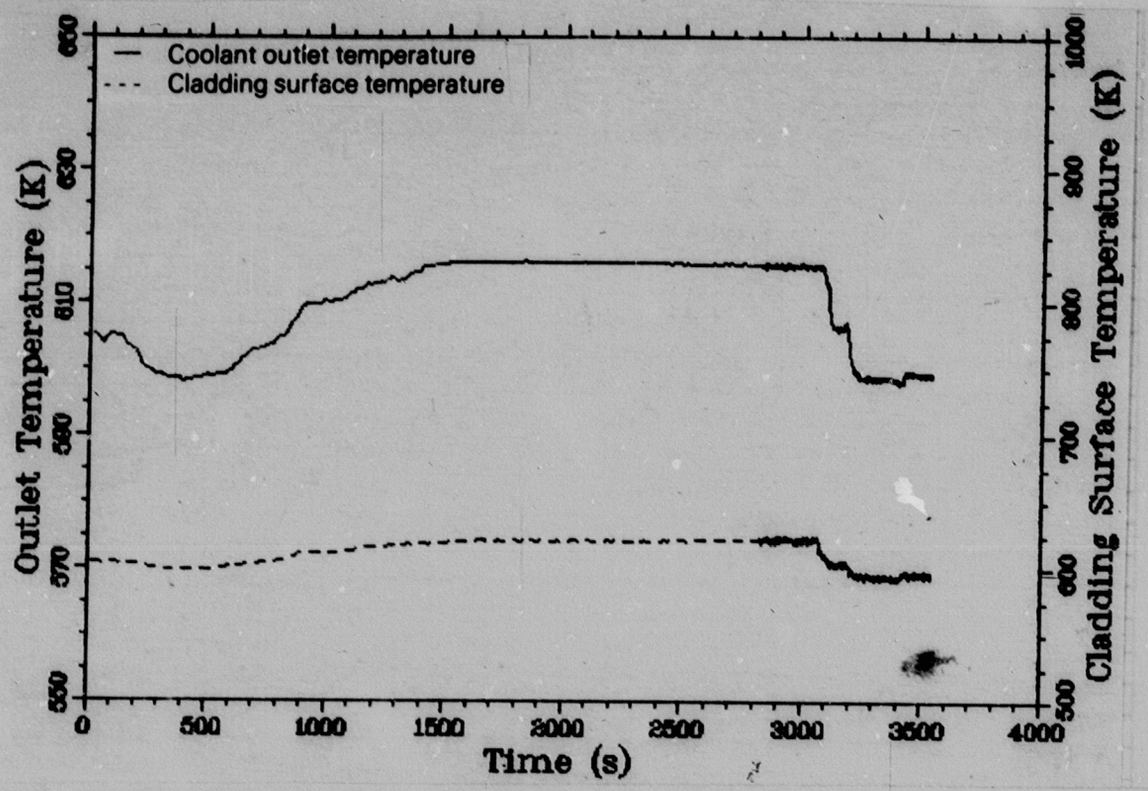


Fig. D-61 Rod A-0021 coolant outlet temperature and cladding surface temperature at 0.69-m and 90-degree location histories during Test PCM-3 DNB Cycle 2.

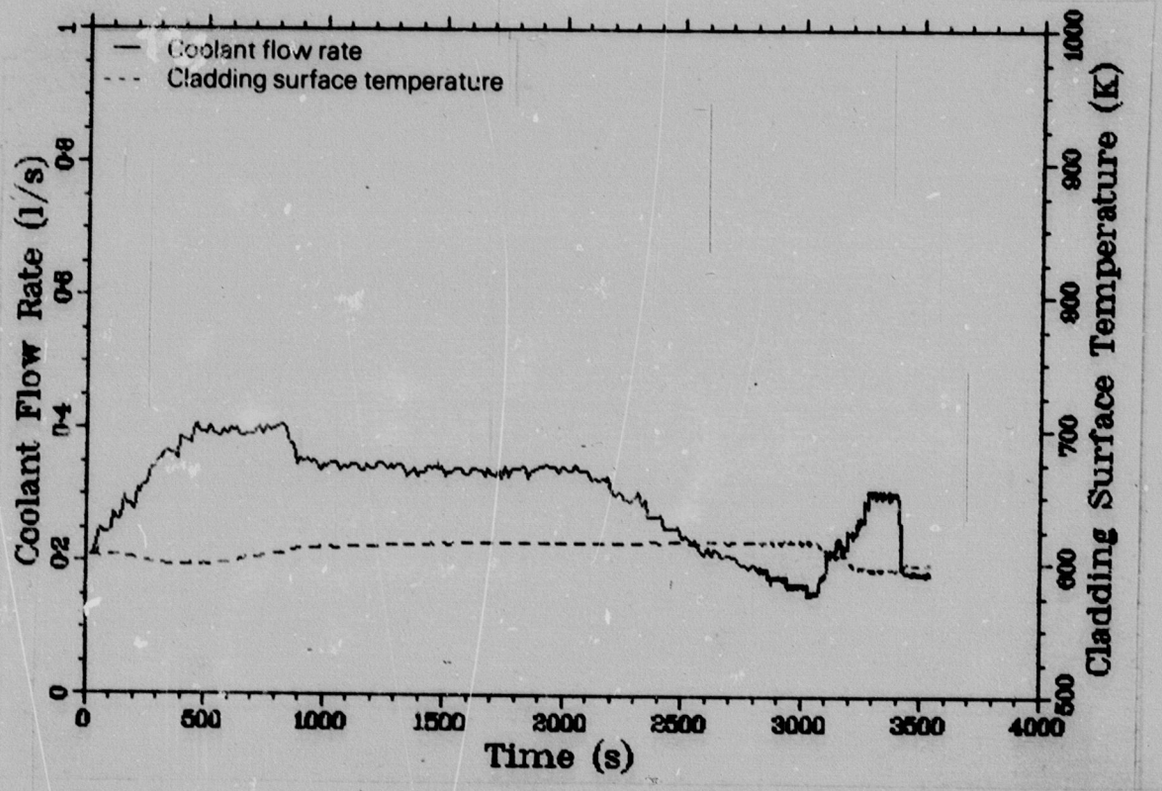


Fig. D-62 Rod A-0021 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 2.

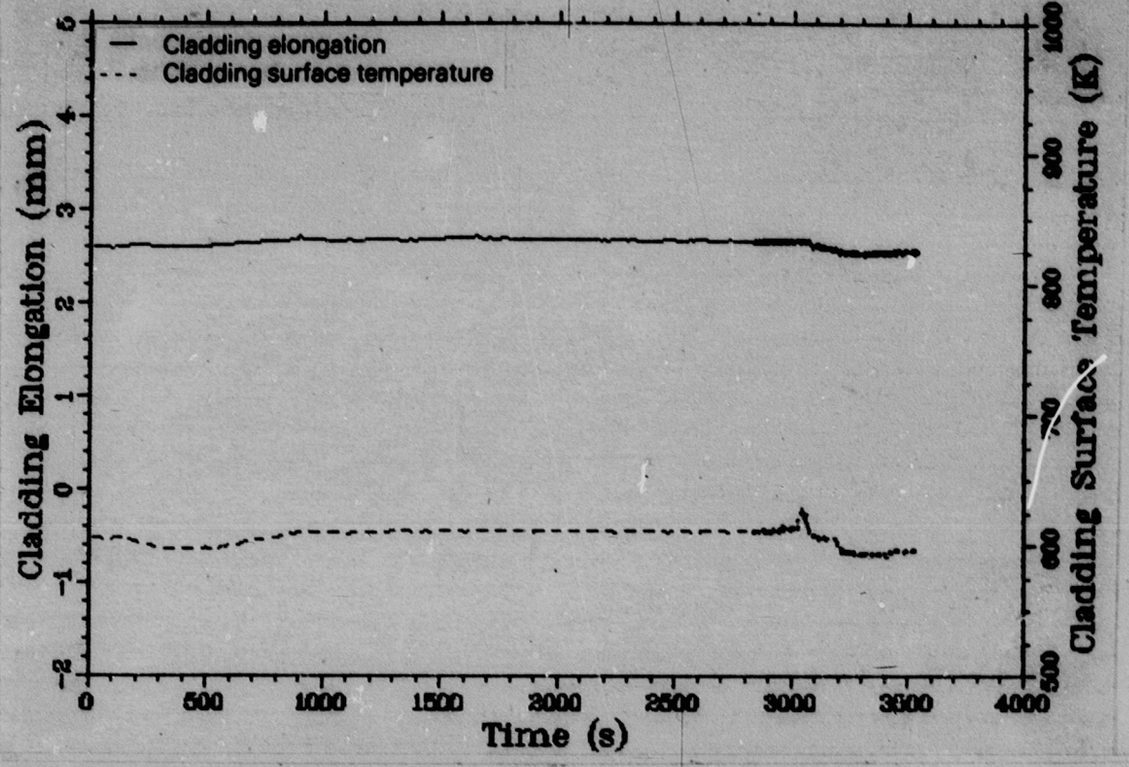


Fig. D-63 Rod A-0021 cladding elongation and cladding surface temperature at 0.89-m and 270-degree location histories during Test PCM-3 DNB Cycle 2.

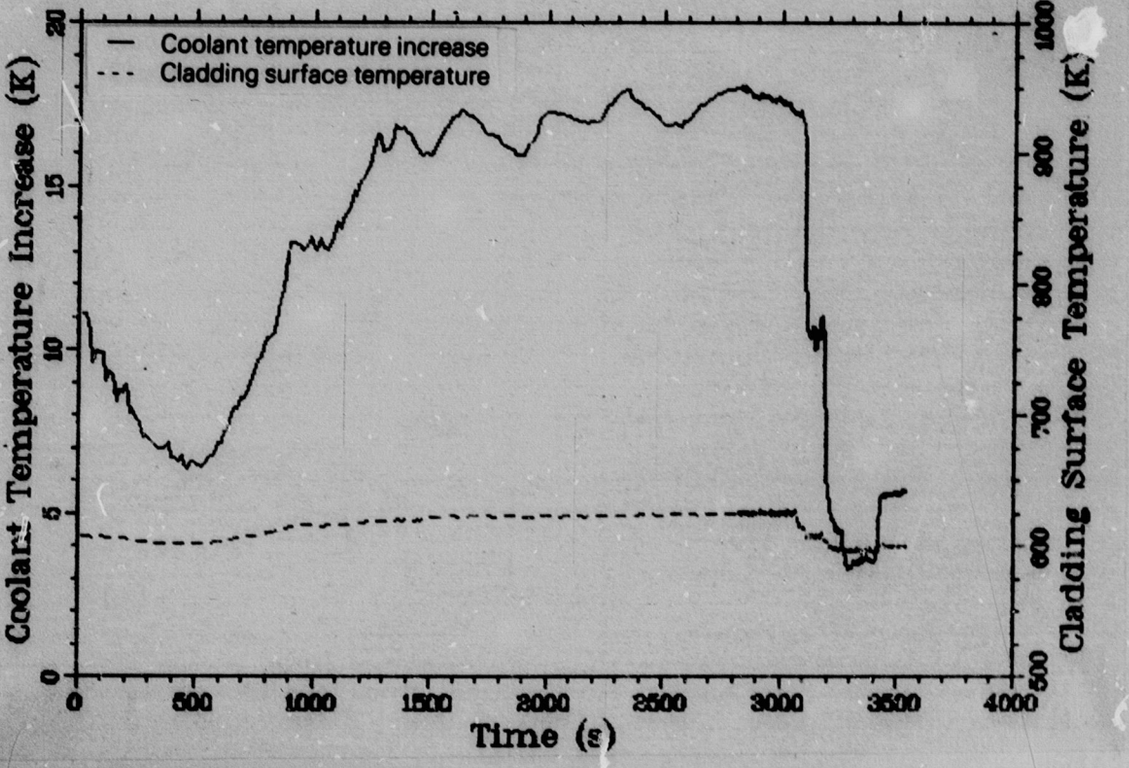


Fig. D-64 Rod UTA-0013 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 2.

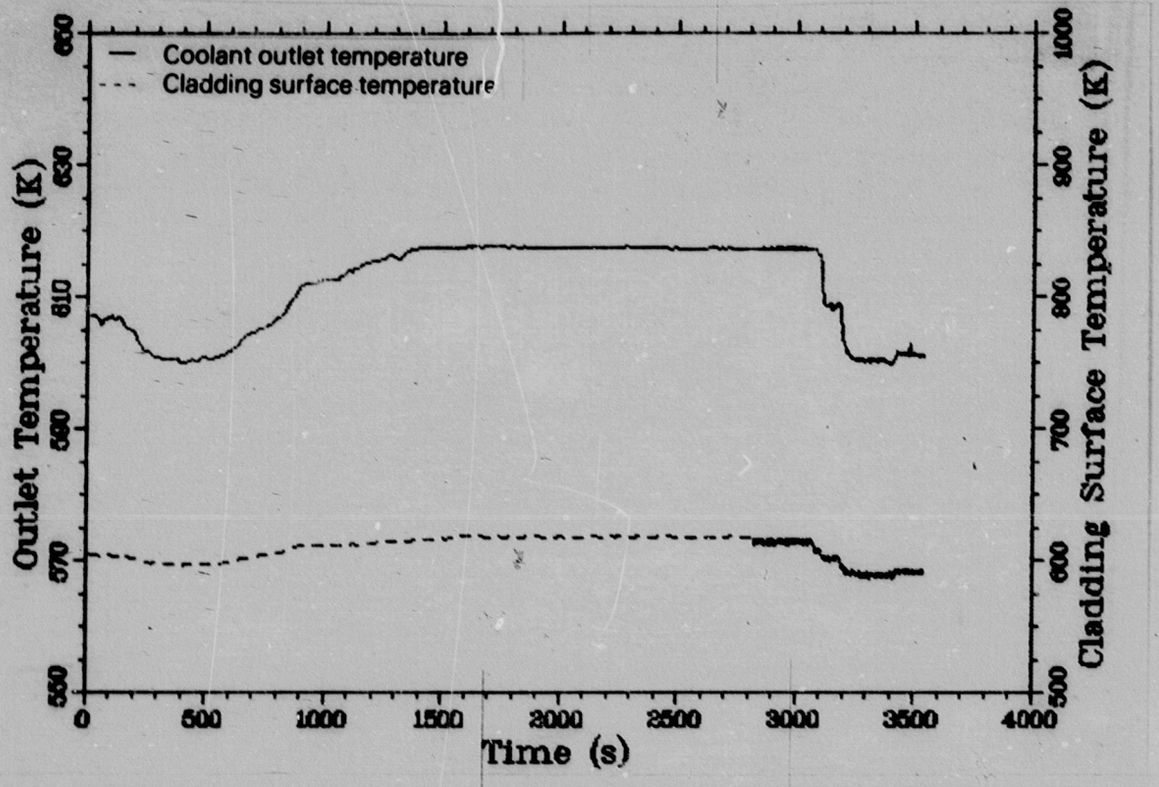


Fig. D-65 Rod UTA-0013 coolant outlet temperature and cladding surface temperature at 0.48-m and 90-degree location histories during Test PCM-3 DNB Cycle 2.

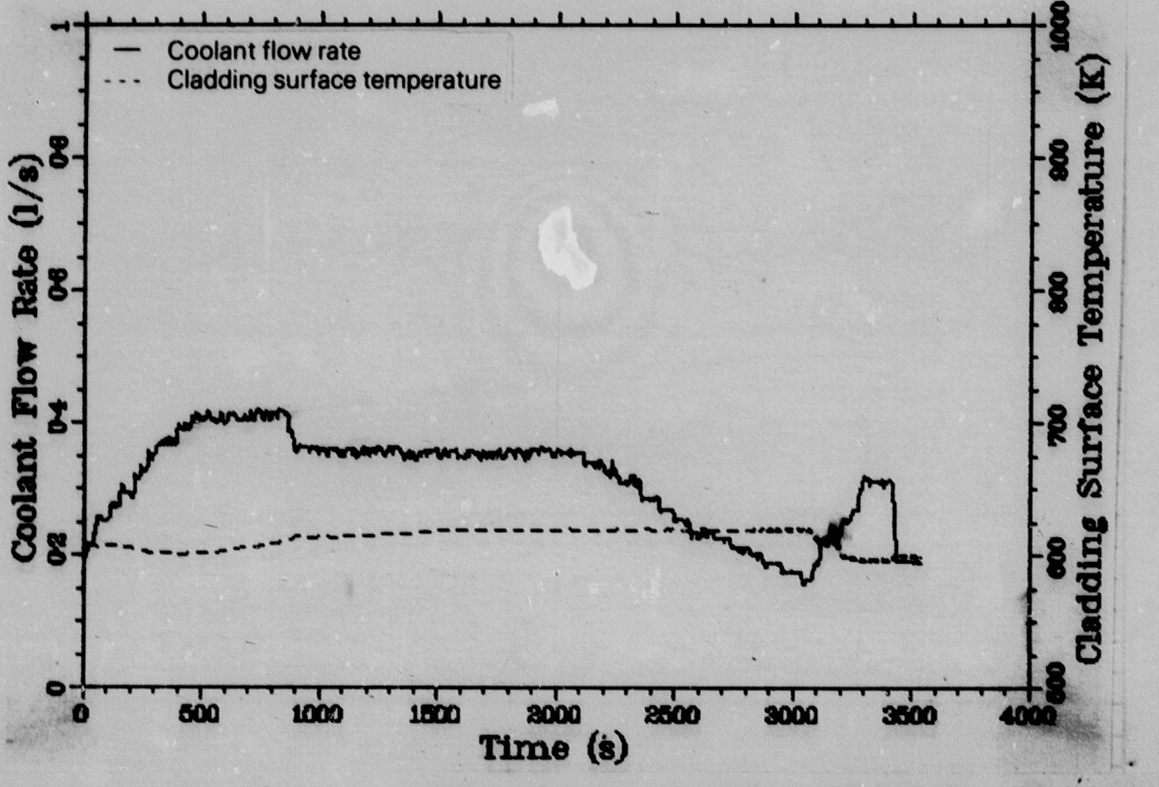


Fig. D-66 Rod UTA-0013 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 2.

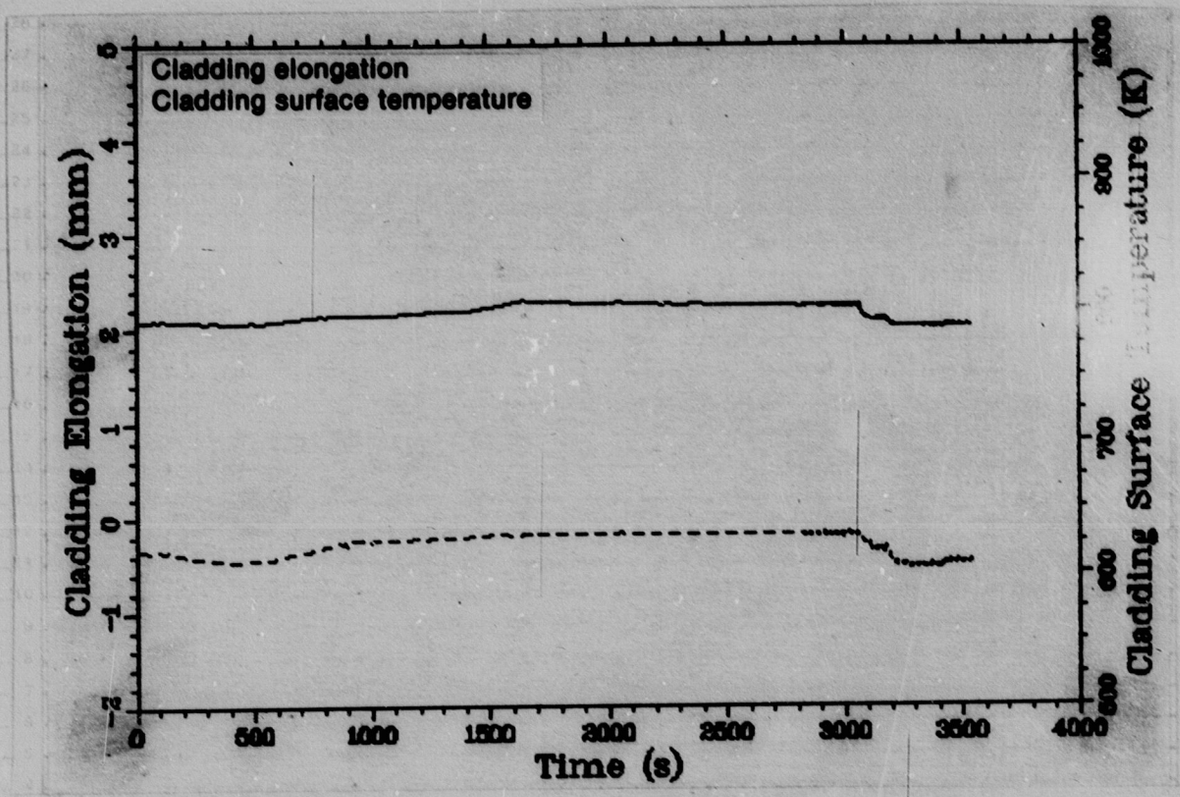


Fig. D-67 Rod UTA-0013 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 2.

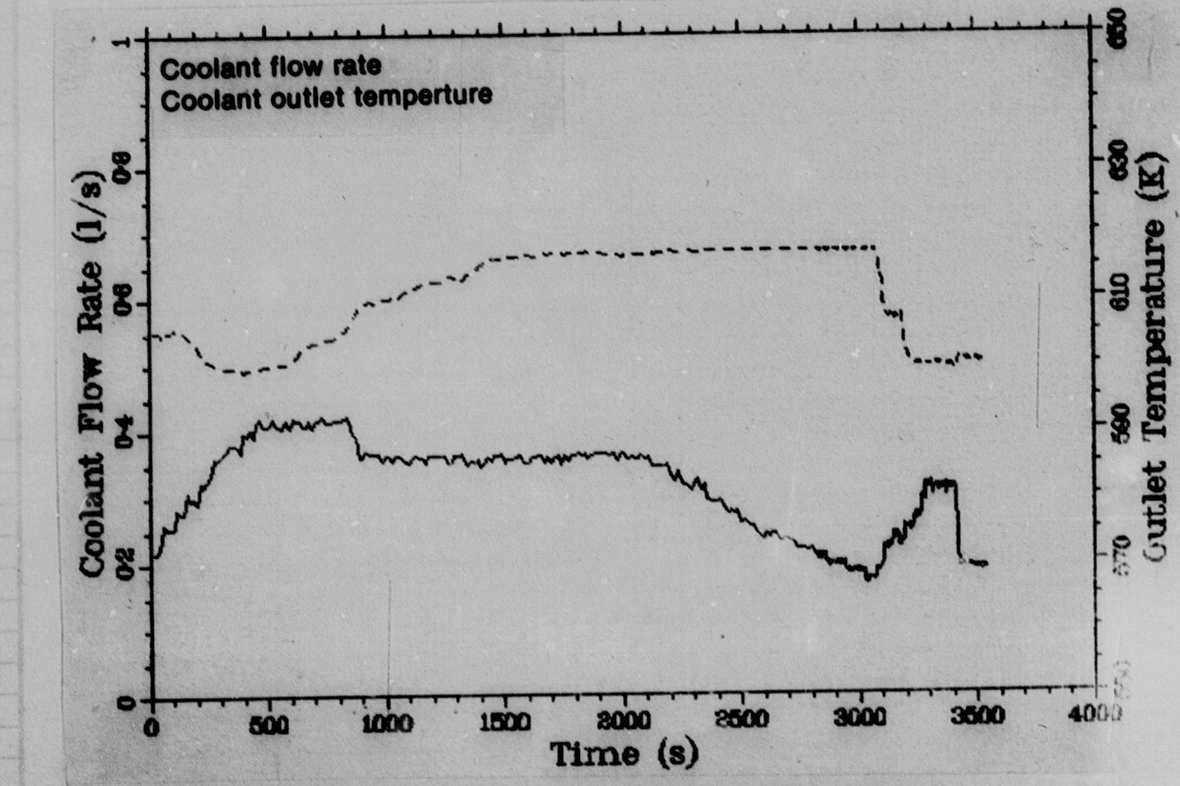


Fig. D-68 Rod A-0015 coolant flow rate and coolant outlet temperature histories during Test PCM-3 DNB Cycle 2.

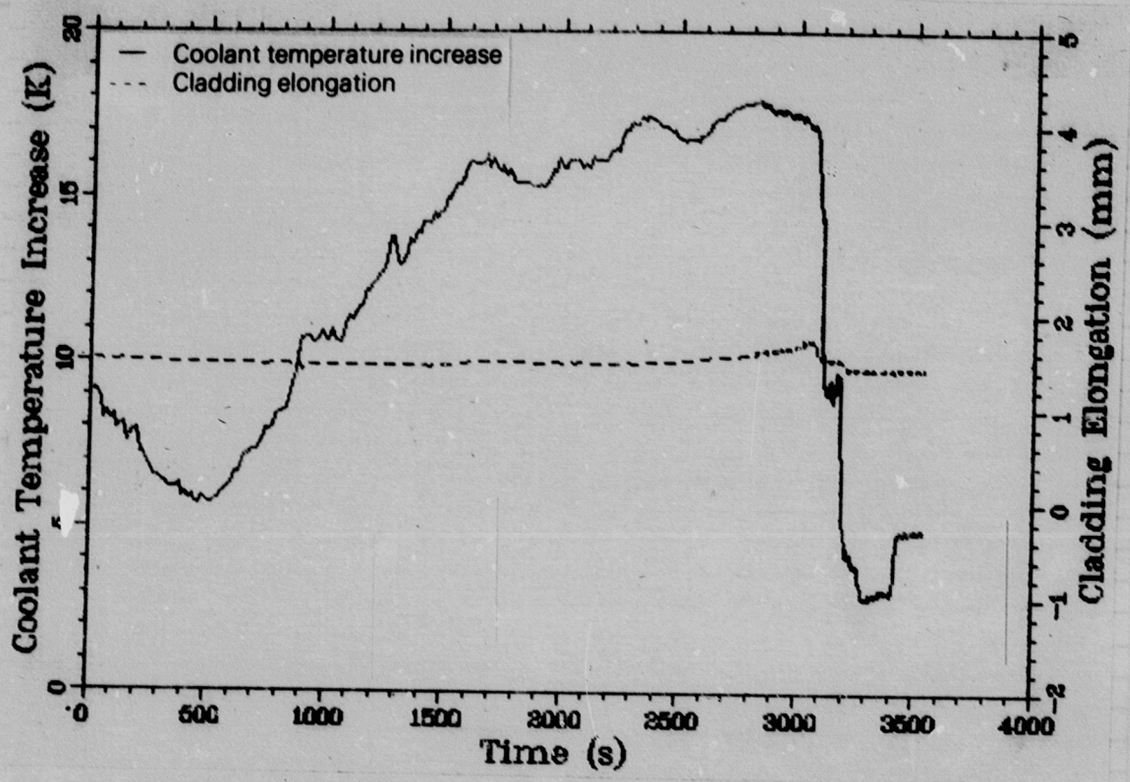


Fig. D-69 Rod A-0015 coolant temperature increase and cladding elongation histories during Test PCM-3 DNB Cycle 2.

DNB CYCLES THREE AND FOUR

Zero time corresponds to Test IRIG time 23:13:00, June 25, 1976.

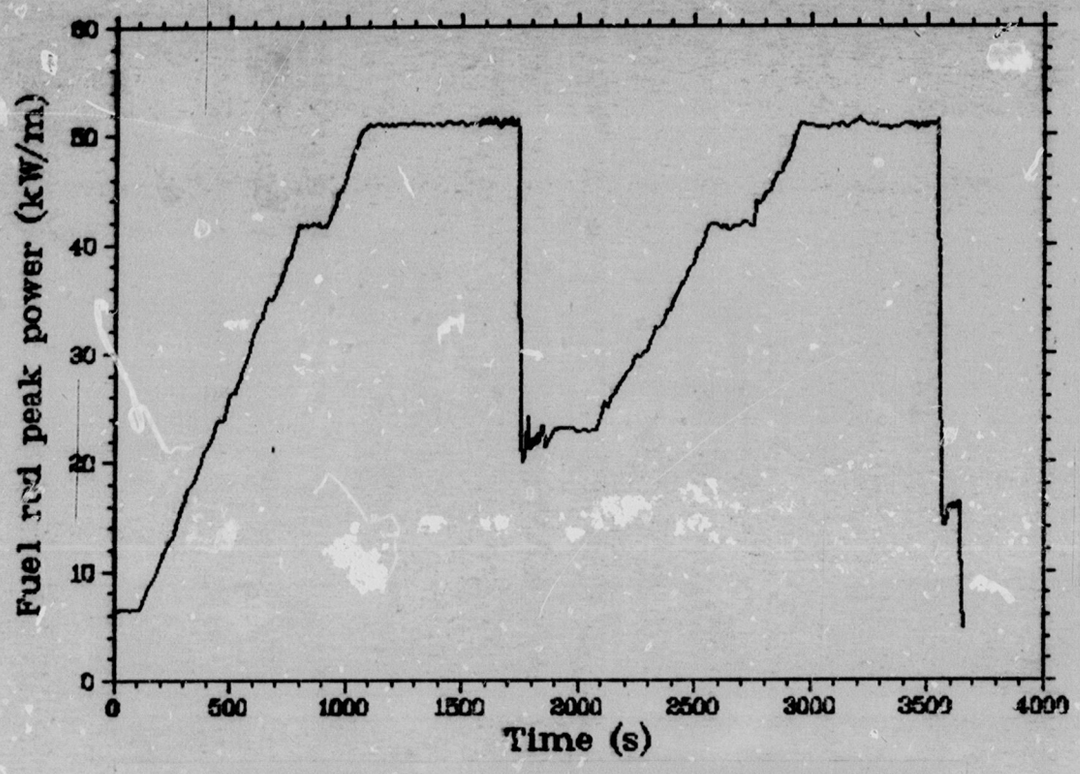


Fig. D-70 Fuel rod peak power time history during Test PCM-3 DNB Cycles 3 and 4.

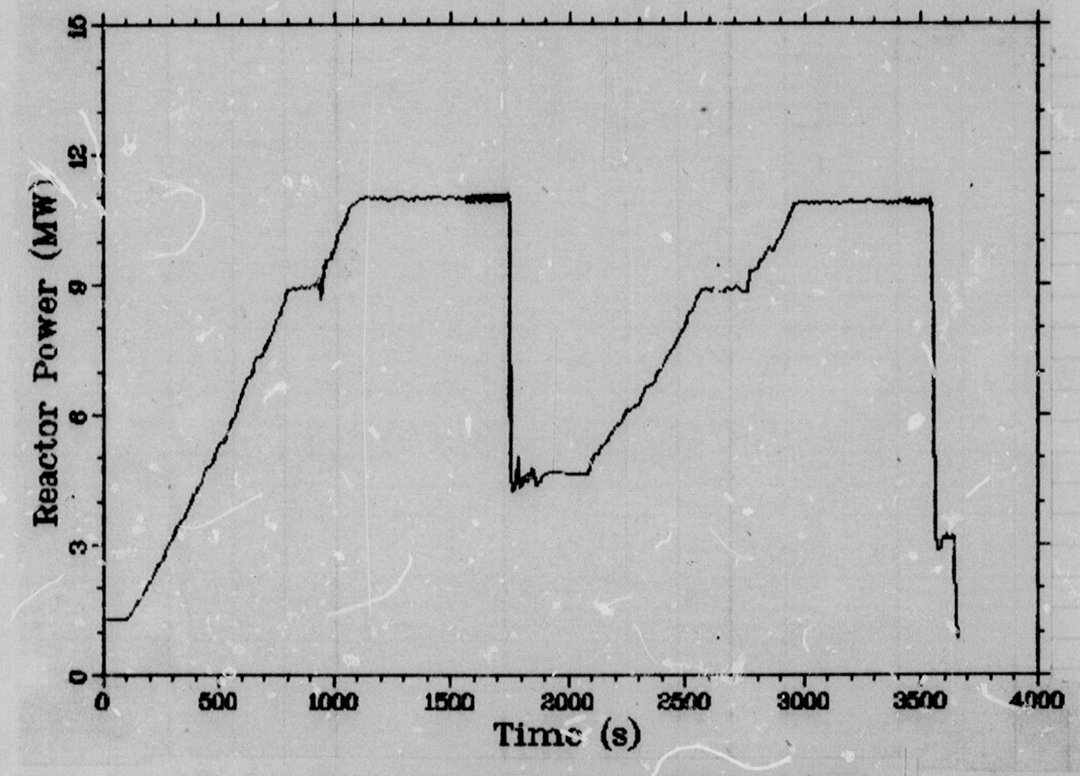


Fig. D-71 PBF core power time history during Test PCM-3 Cycles 2 and 4.

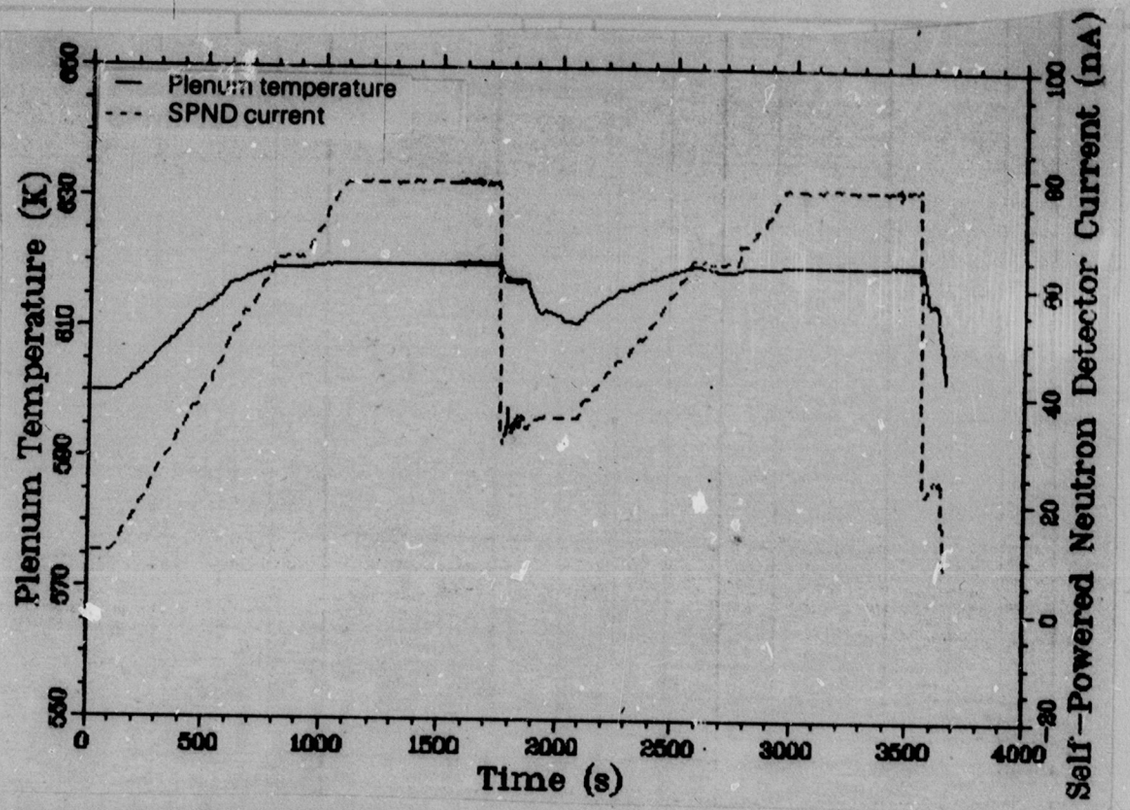


Fig. D-72 Plenum temperature and SPND current at 0.31-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

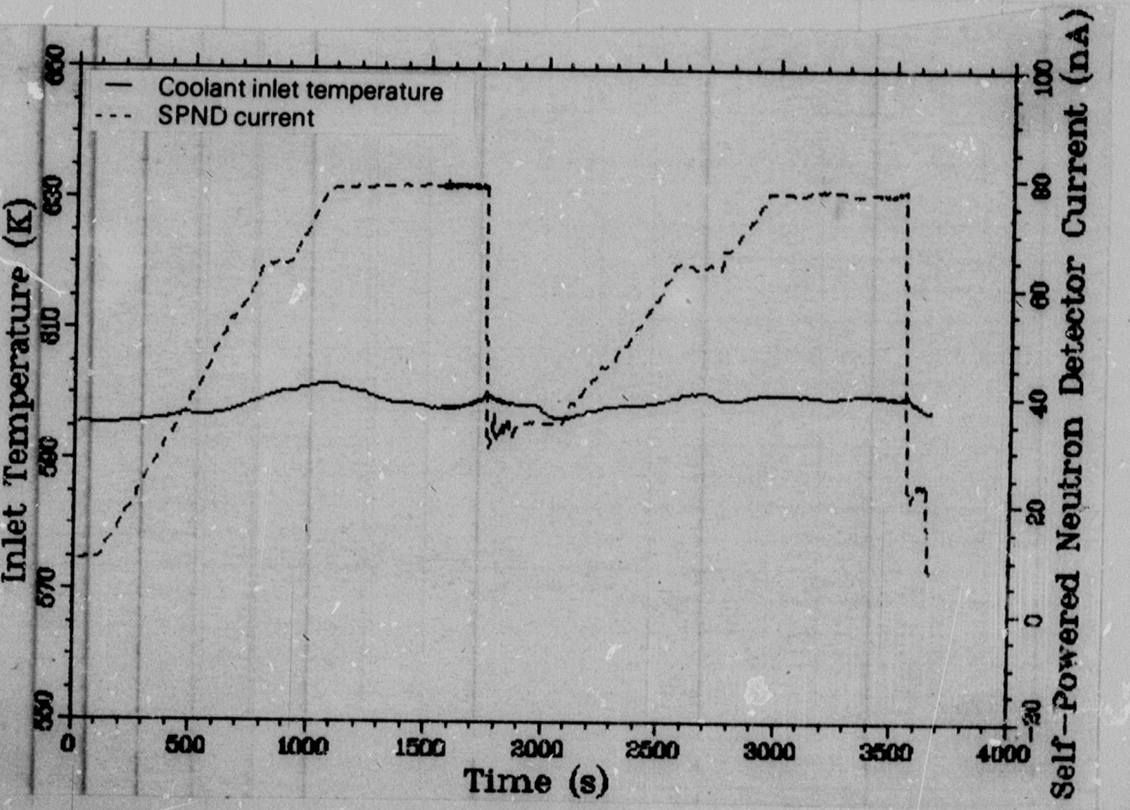


Fig. D-73 Coolant inlet temperature No. 1 and SPND current at 0.47-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

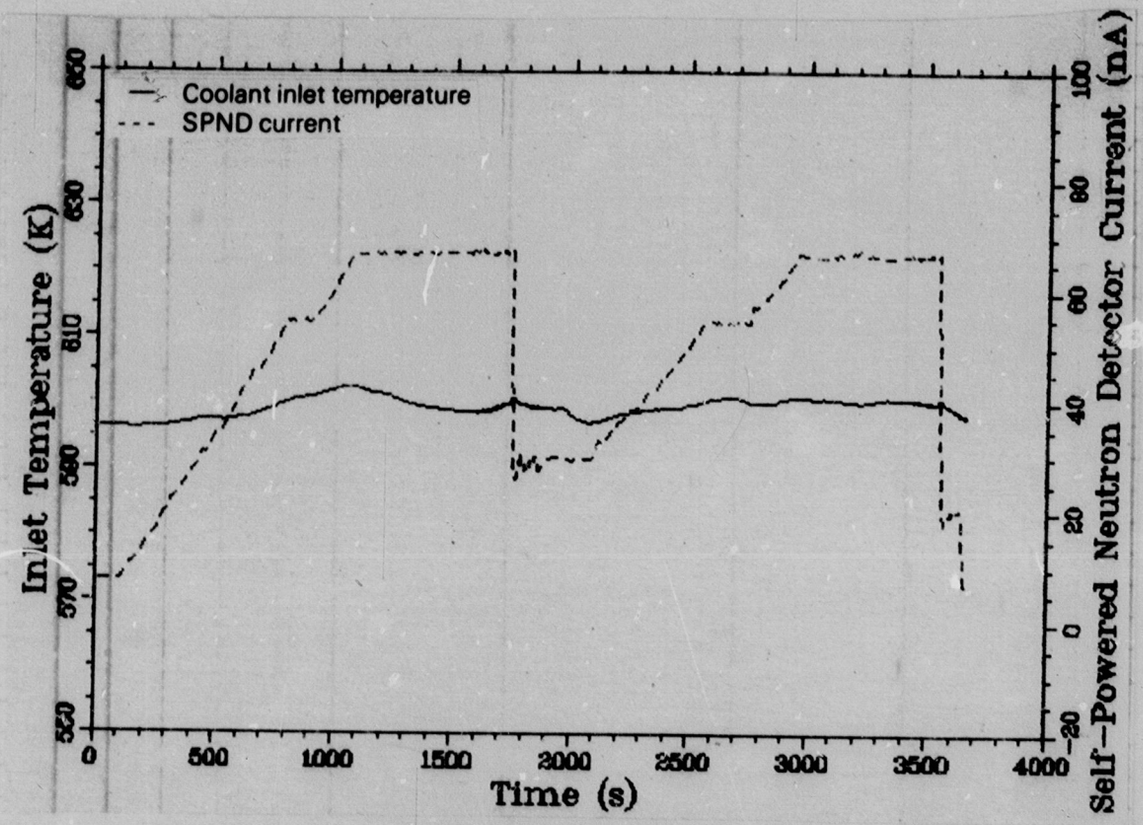


Fig. D-74 Coolant inlet temperature No. 2 and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

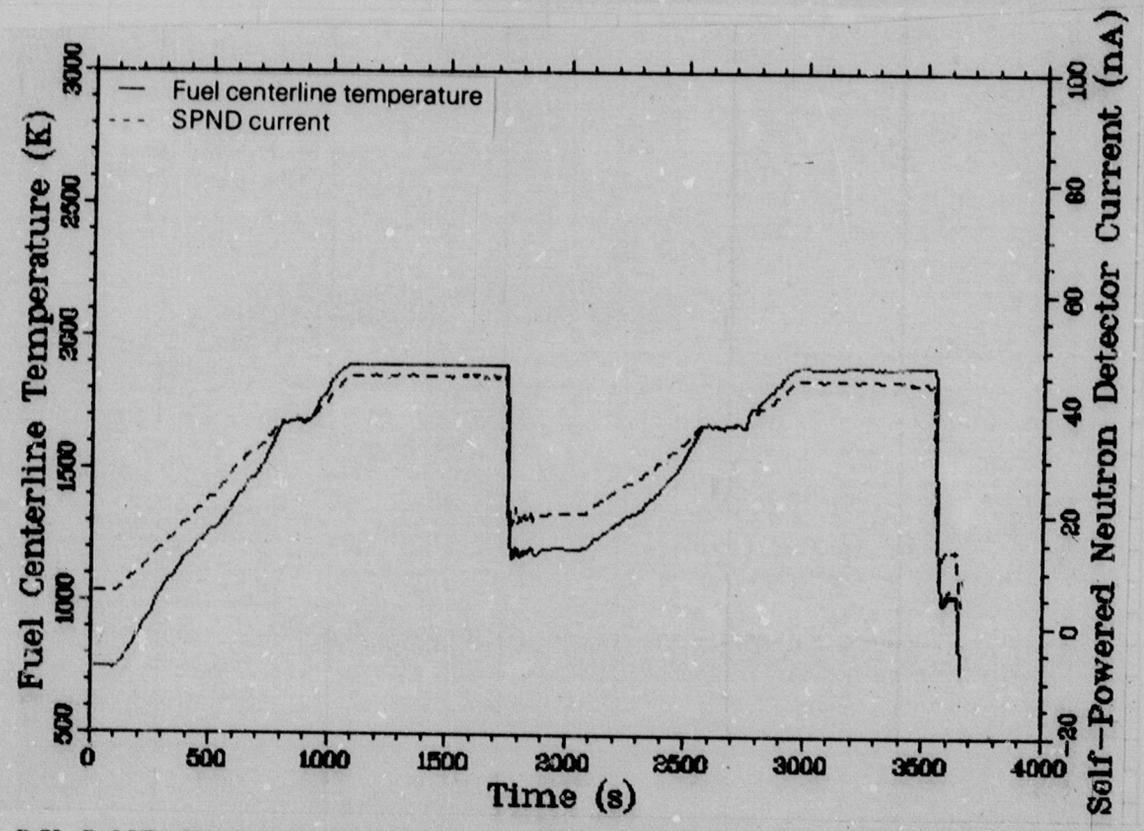


Fig. D-75 Rod UTA-0011 fuel centerline temperature and SPND current at 0.78-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

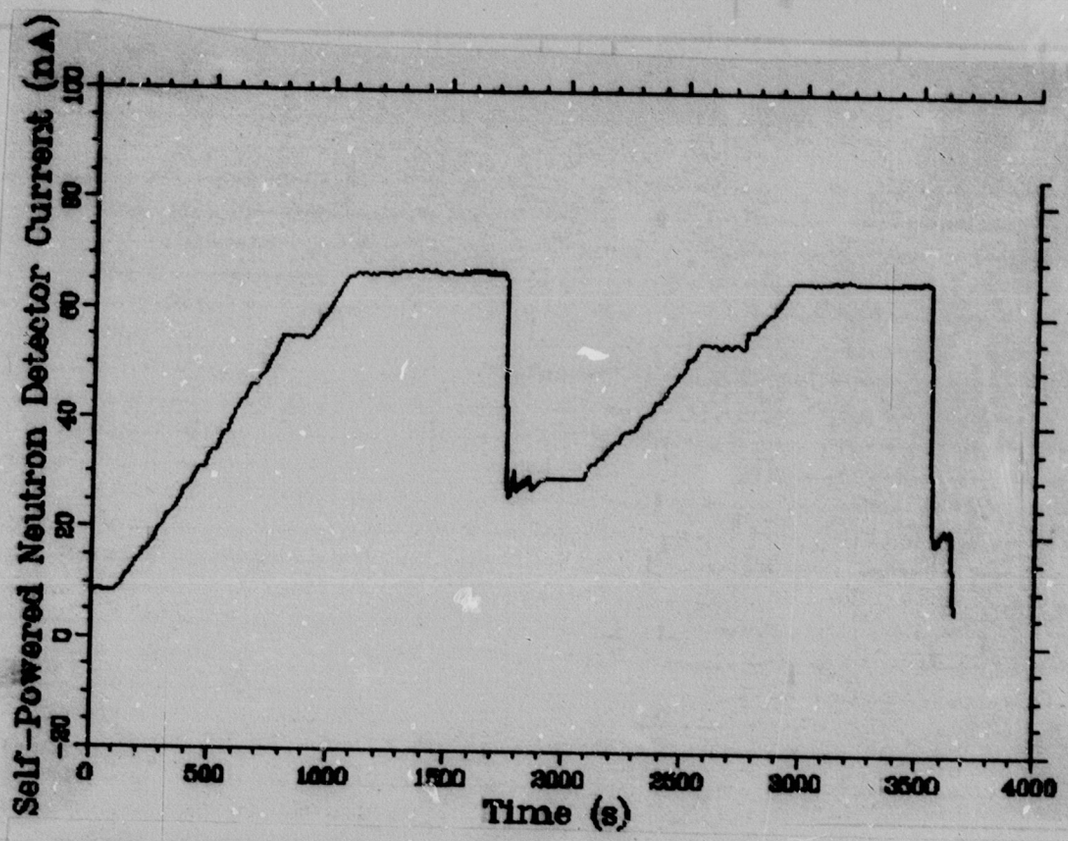


Fig. D-76 Rod UTA-0013 SPND current at 0.63-m elevation history during Test PCM-3 DNB Cycles 3 and 4.

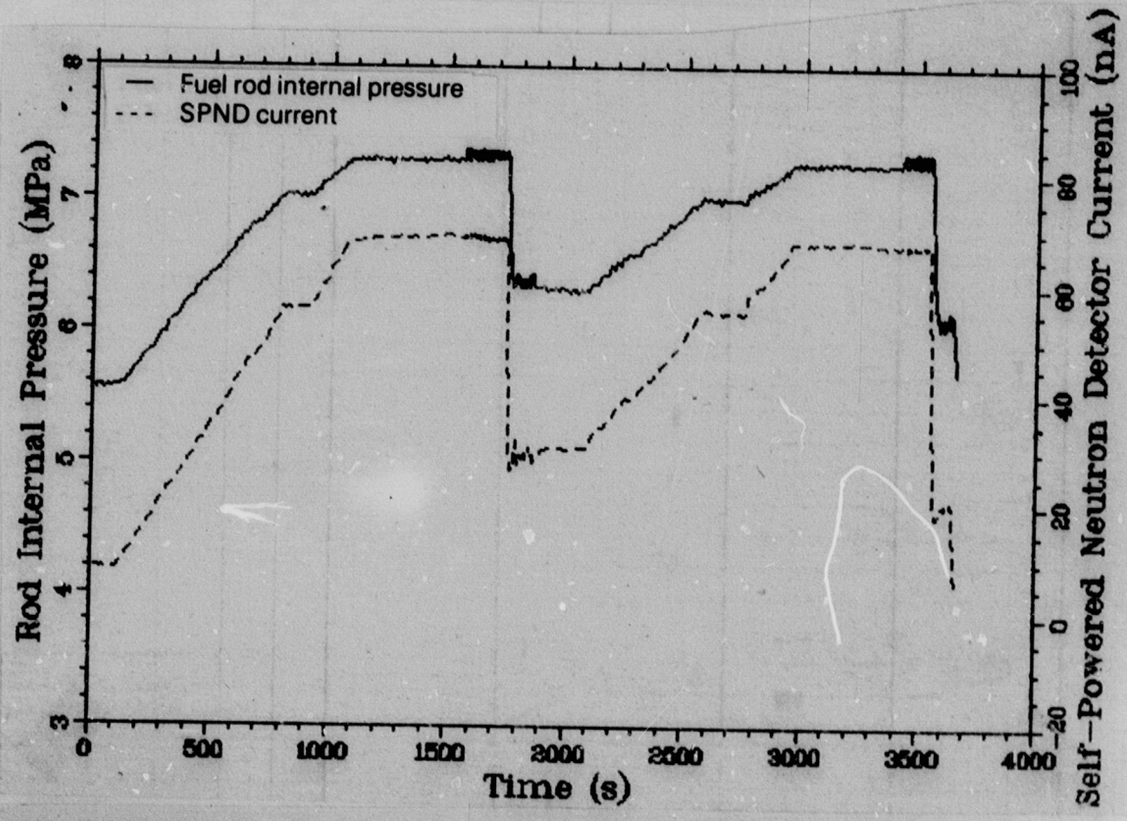


Fig. D-77 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

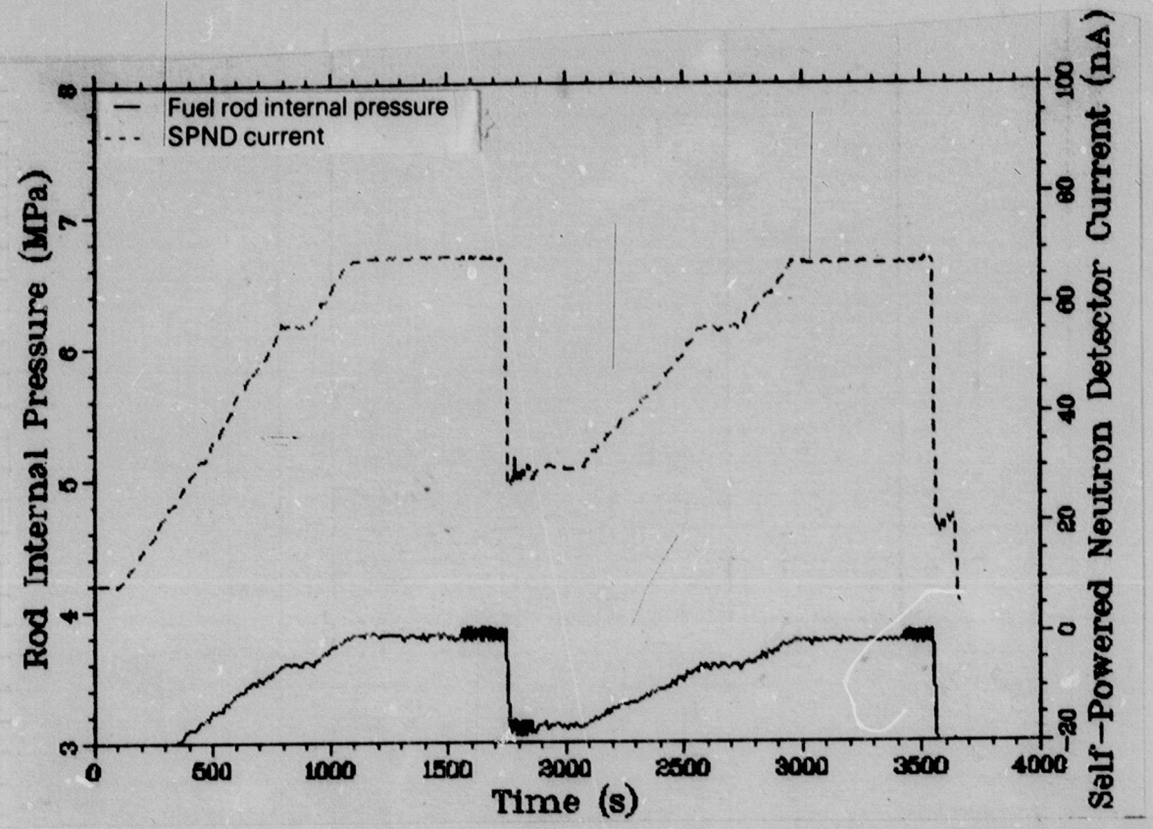


Fig. D-78 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycles 3 and 4.

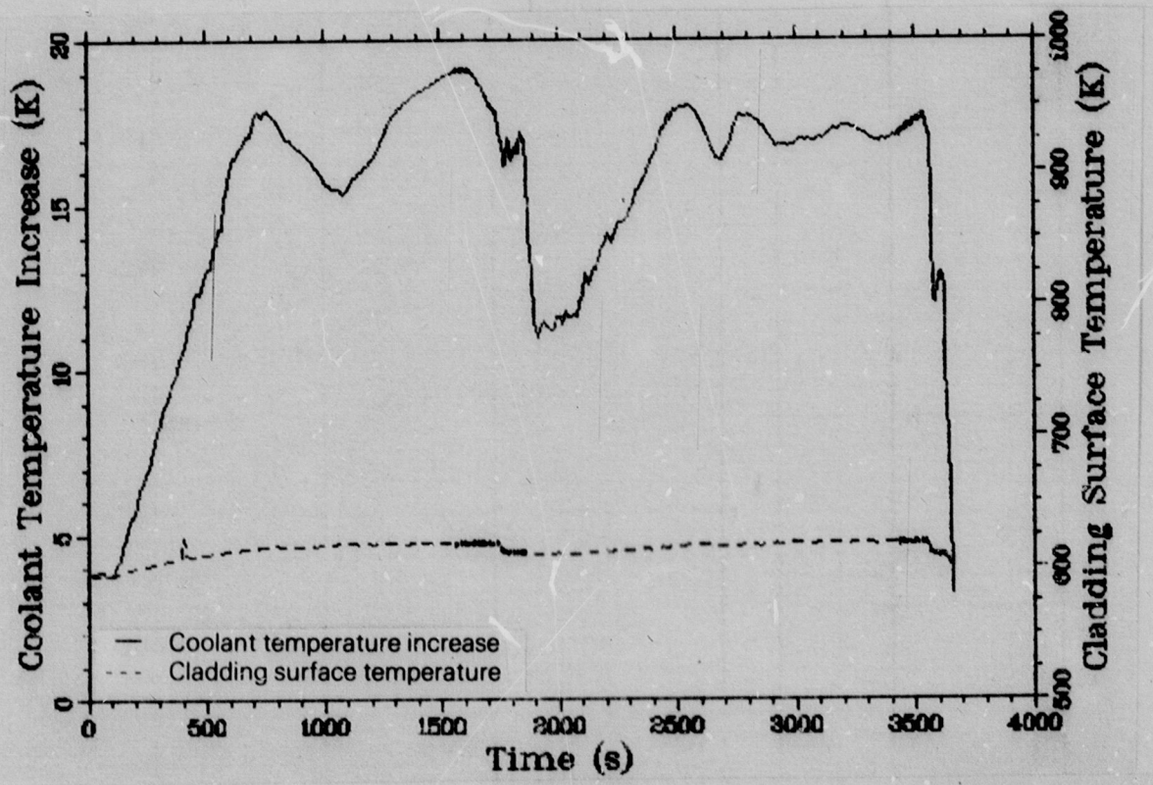


Fig. D-79 Rod UTA-0011 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

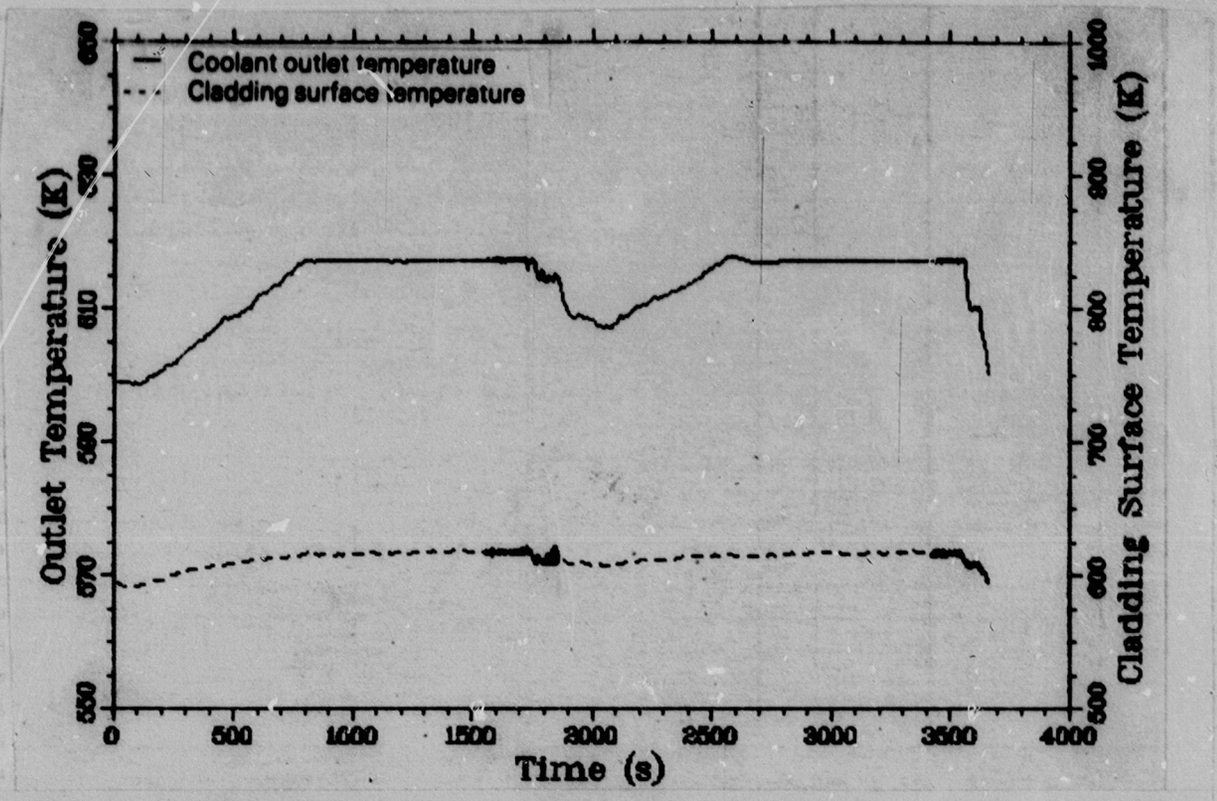


Fig. D-80 Rod UTA-0011 coolant outlet temperature and cladding surface temperature at 0.74-m and 90-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

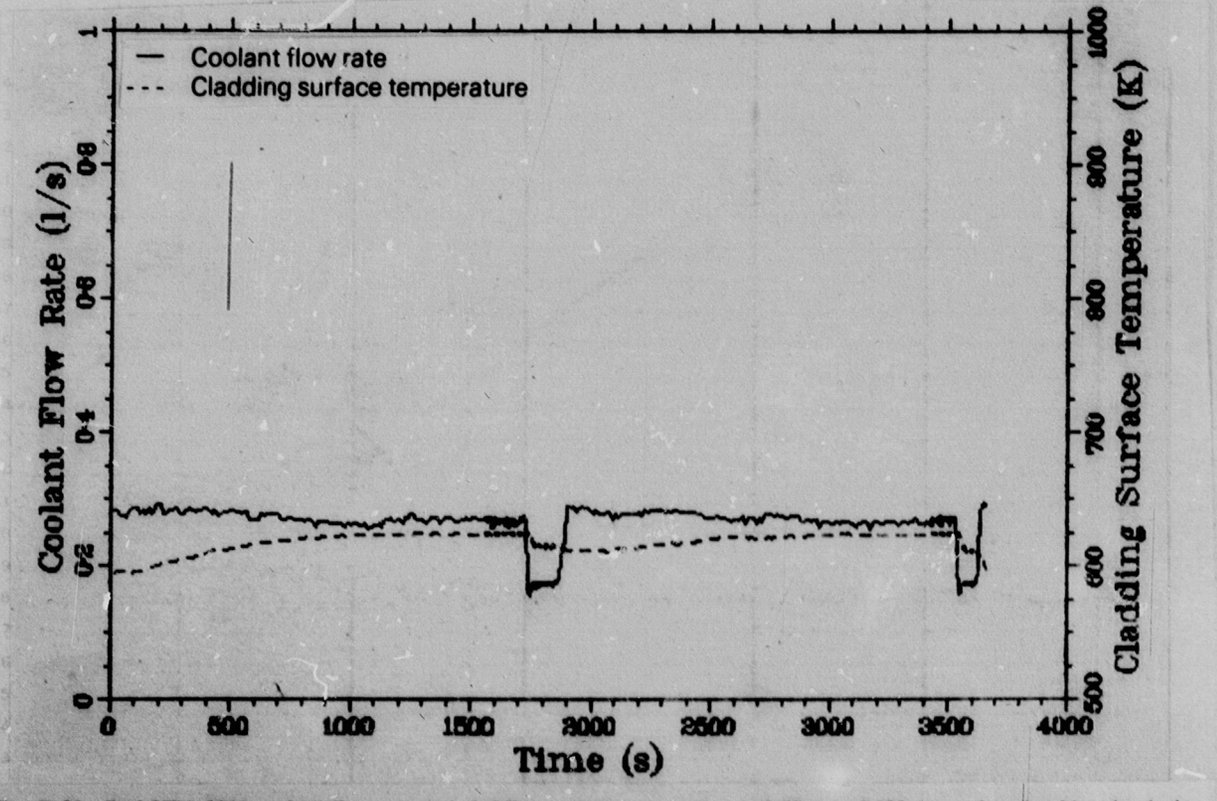


Fig. D-81 Rod UTA-0011 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

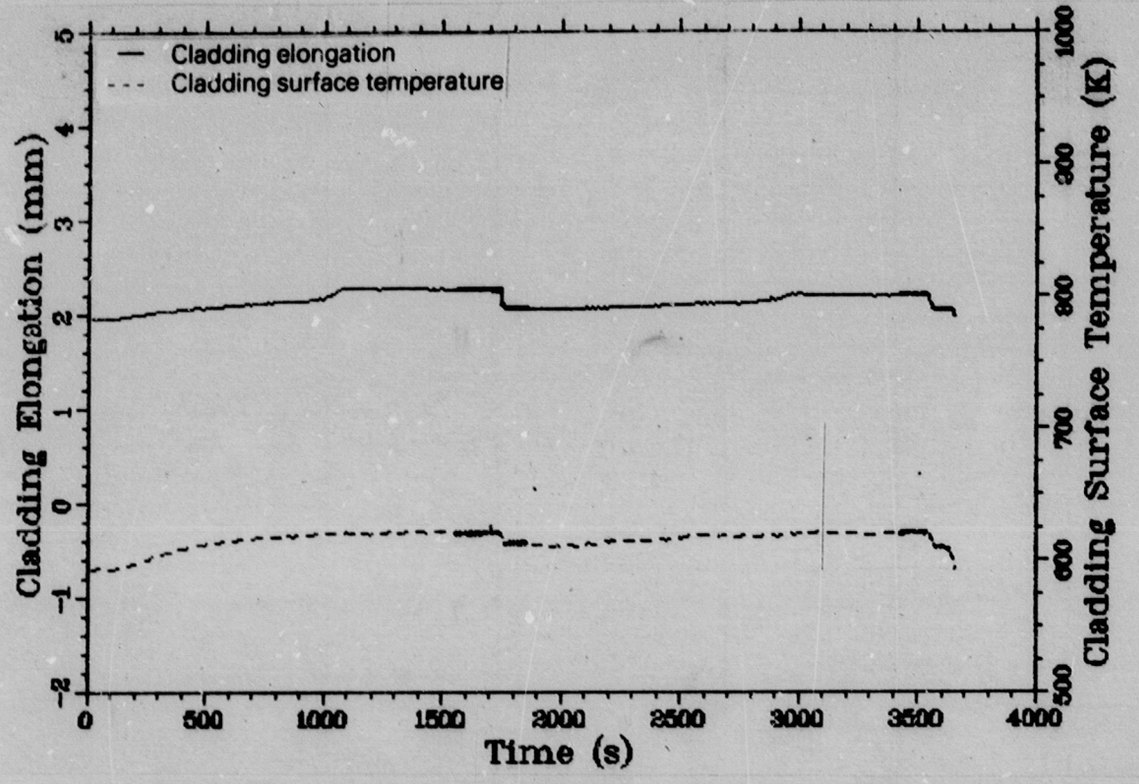


Fig. D-82 Rod UTA-0011 cladding elongation and cladding surface temperature at 0.63-m amd 270-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

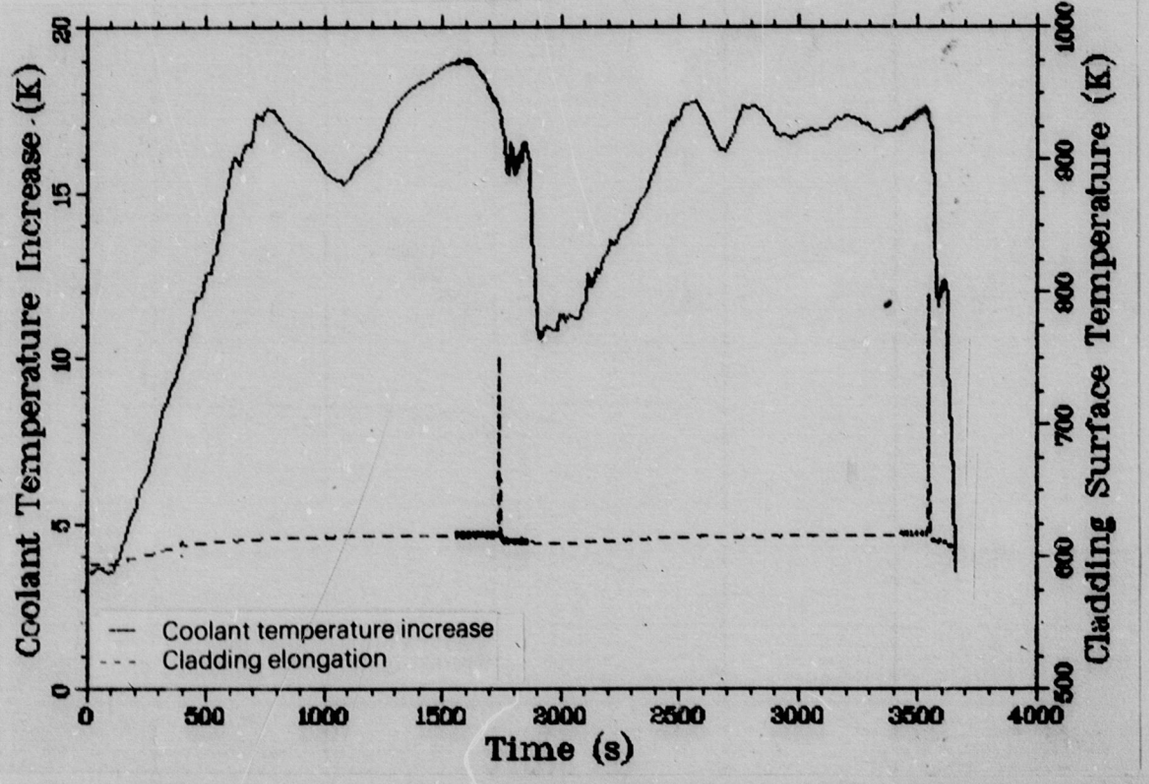


Fig. D-83 Rod A-0021 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

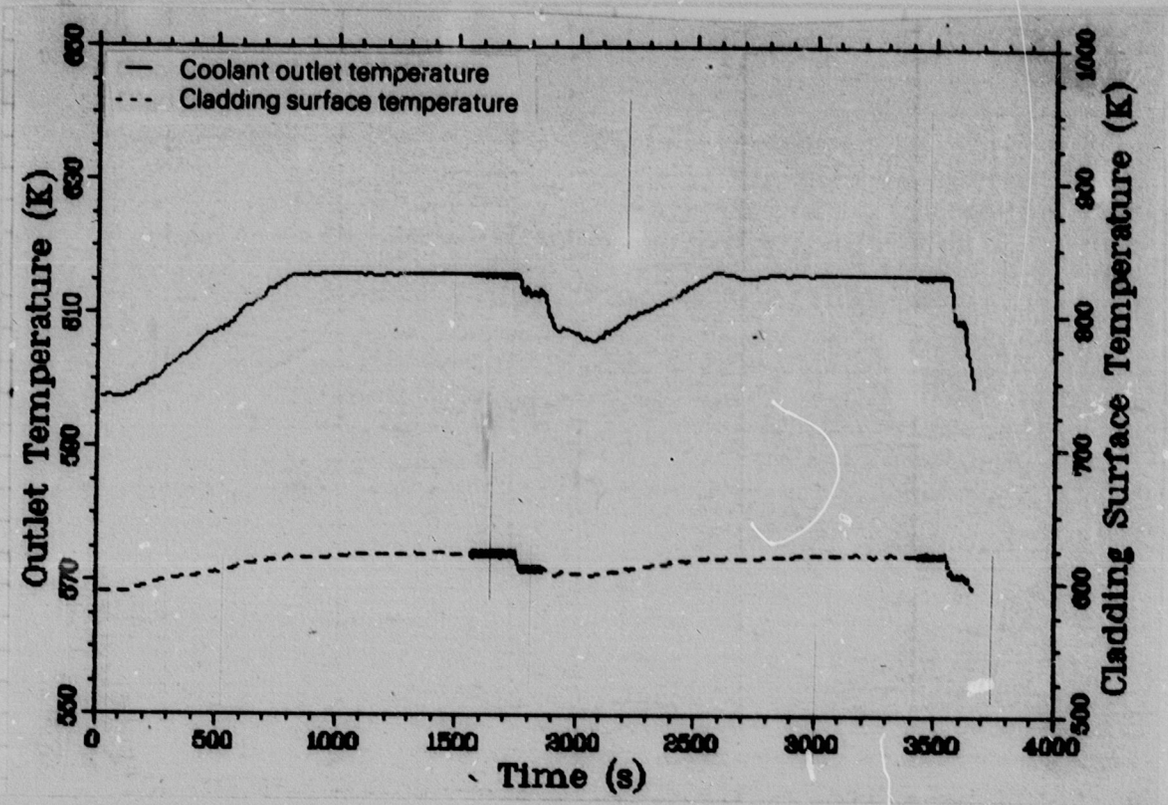


Fig. D-84 Rod A-0021 coolant outlet temperature and cladding surface temperature at 0.69-m and 90-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

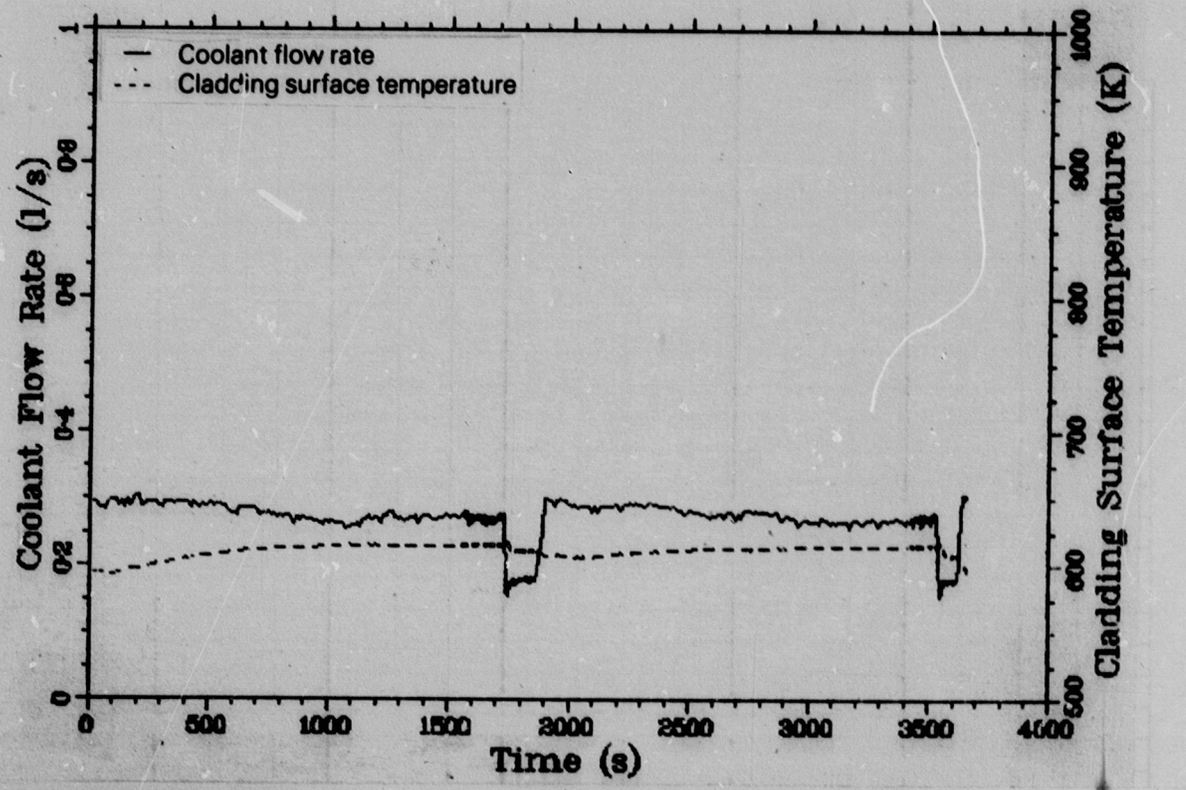


Fig. D-85 Rod A-0021 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

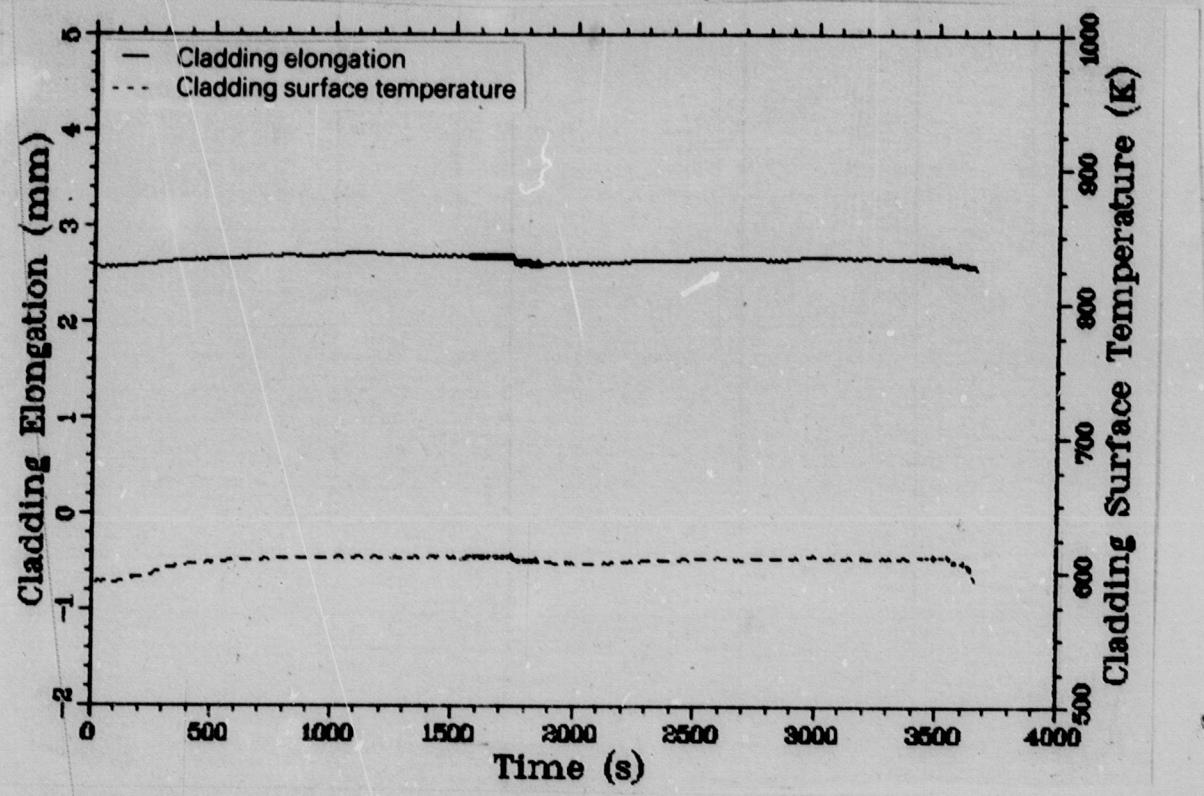


Fig. D-86 Rod A-0021 cladding elongation and cladding surface temperature at 0.89-m and 270-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

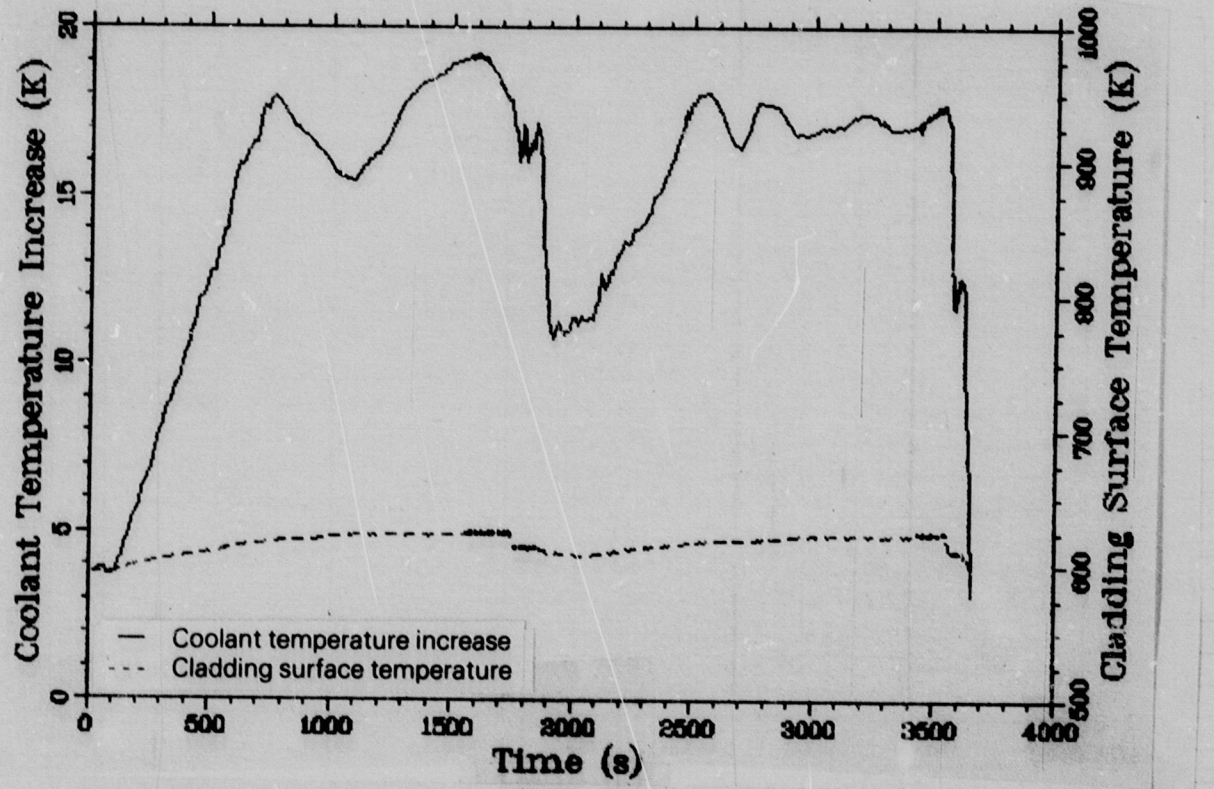


Fig. D-87 Rod UTA-0013 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

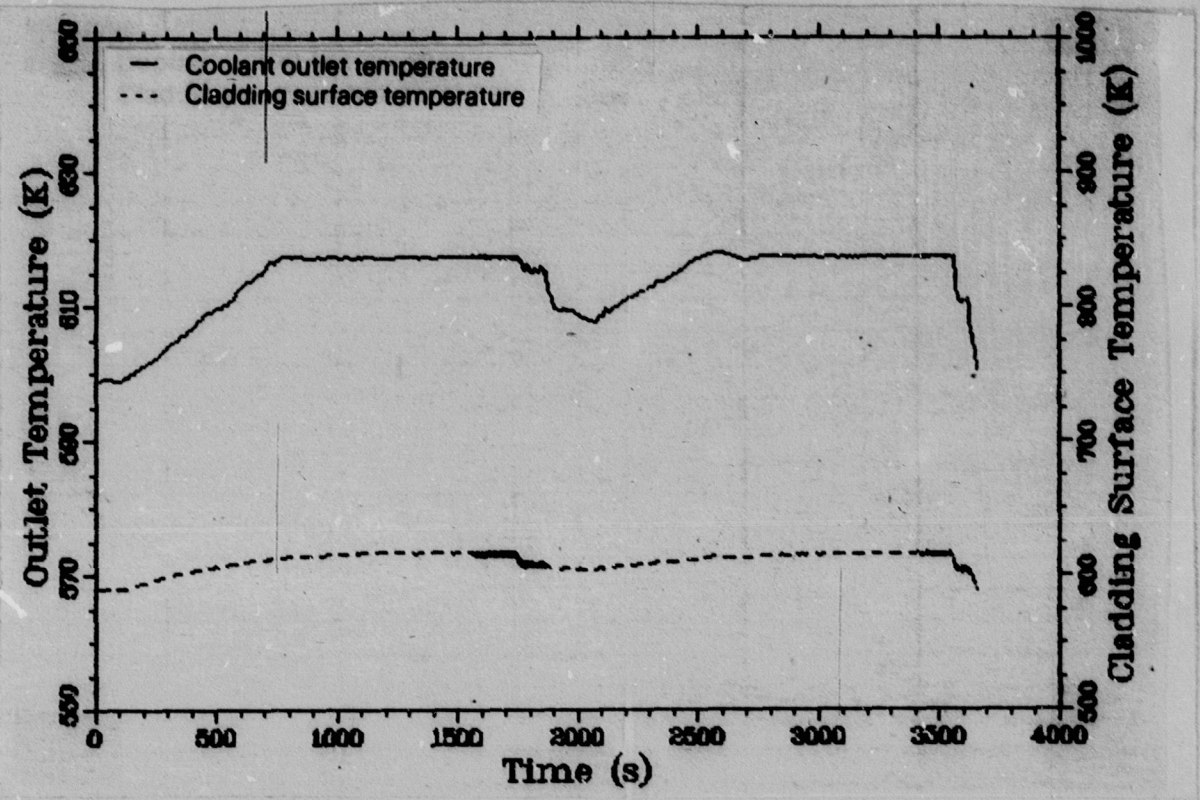


Fig. D-88 Rod UTA-0013 coolant outlet temperature and cladding surface temperature at 0.48-m and 90-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

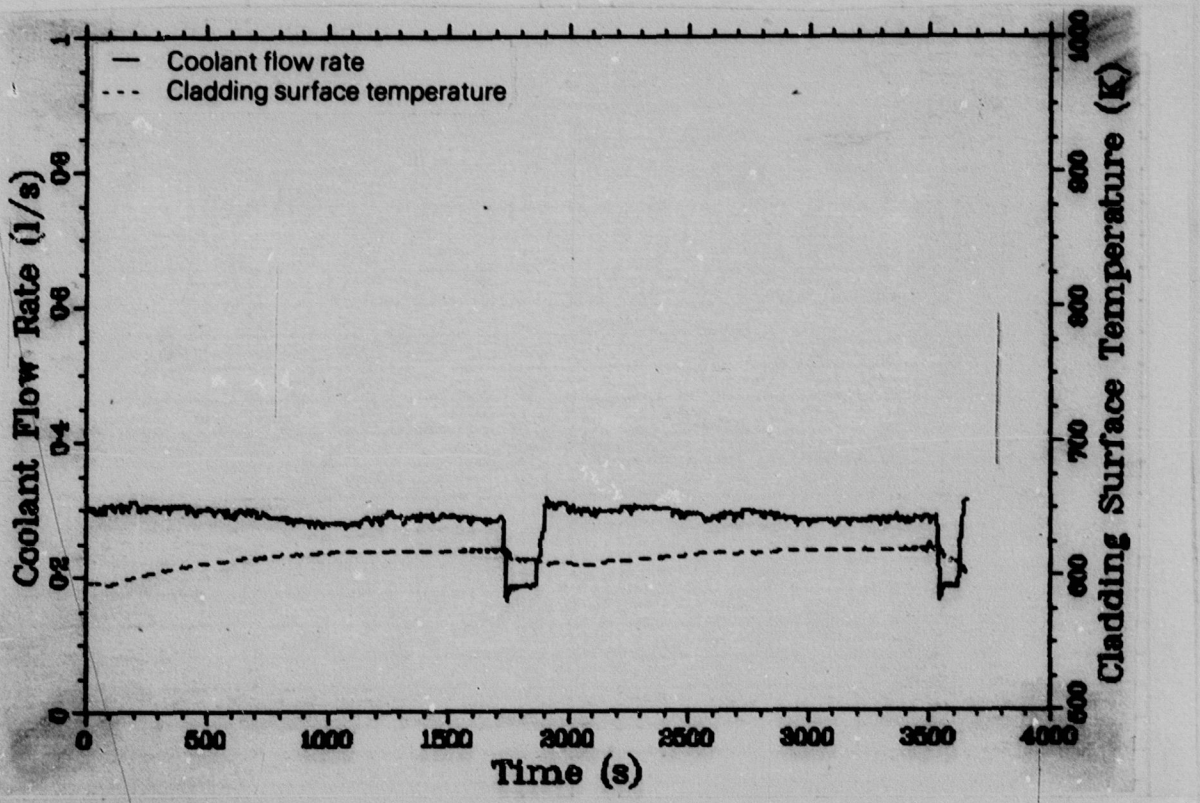


Fig. D-89 Rod UTA-0013 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

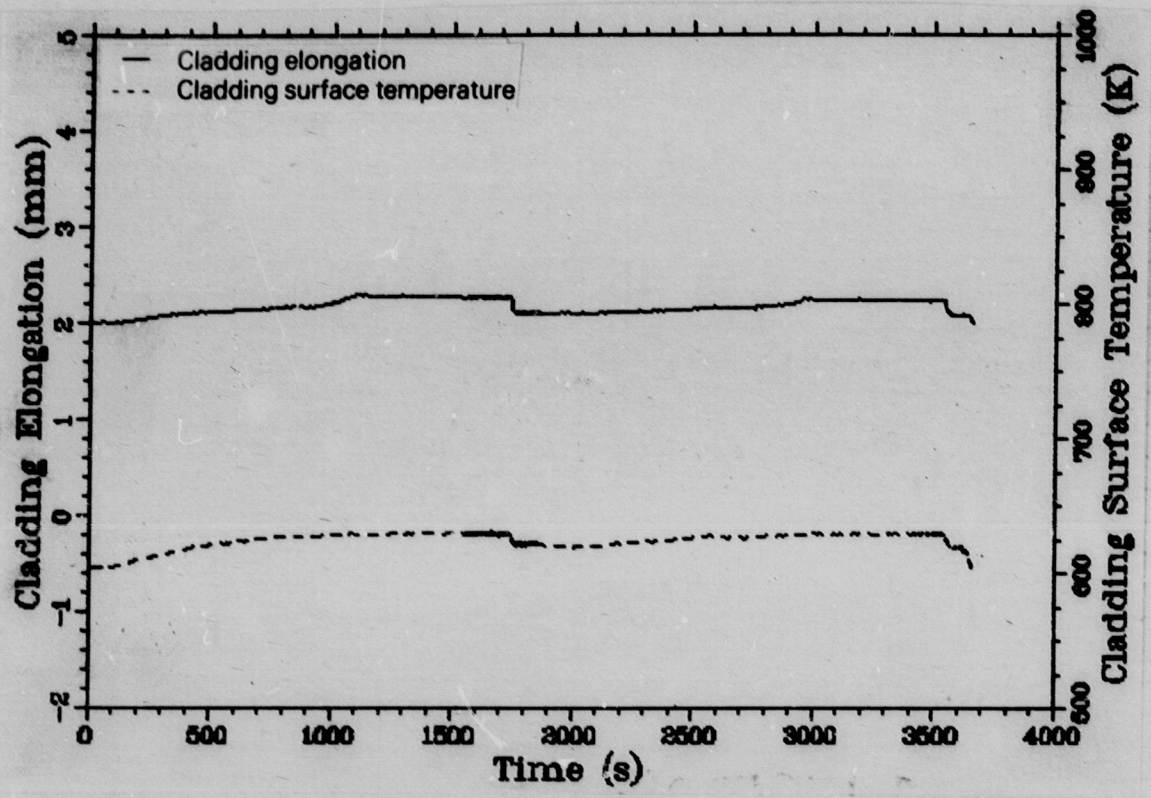


Fig. D-90 Rod UTA-0013 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycles 3 and 4.

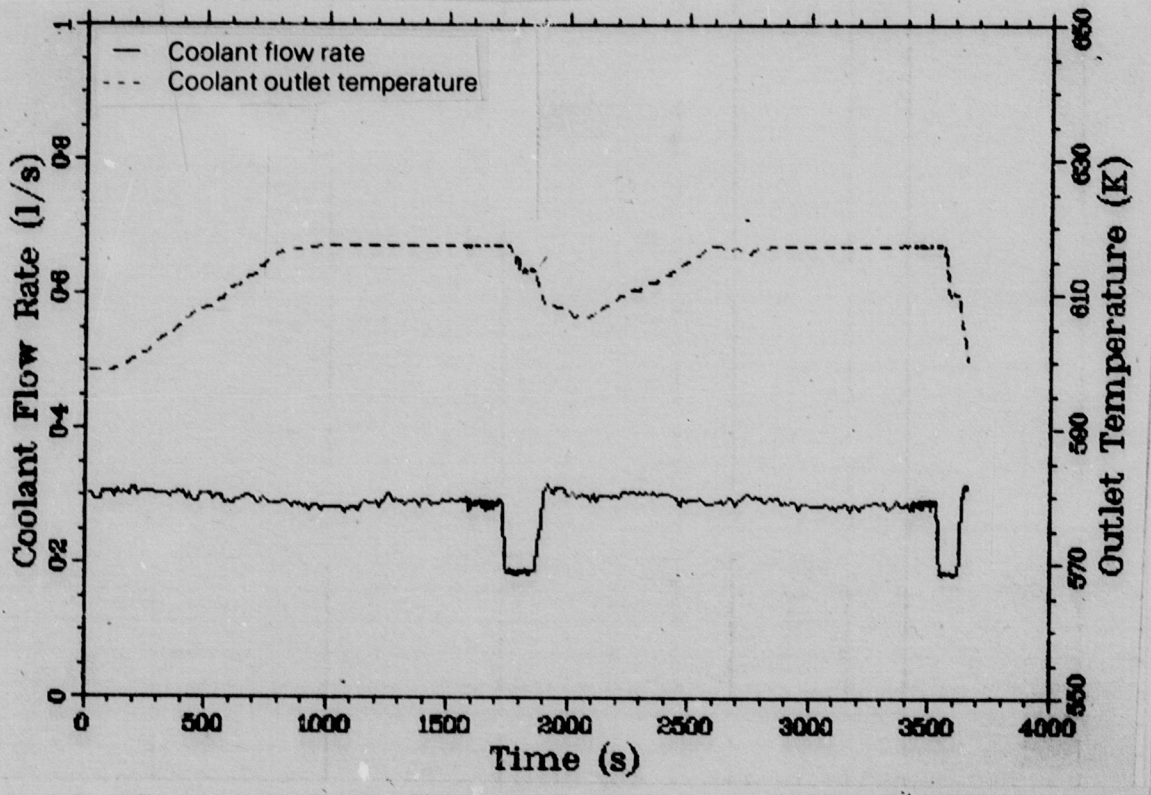


Fig. D-91 Rod A-0015 coolant flow rate and coolant outlet temperature histories during Test PCM-3 DNB Cycles 3 and 4.

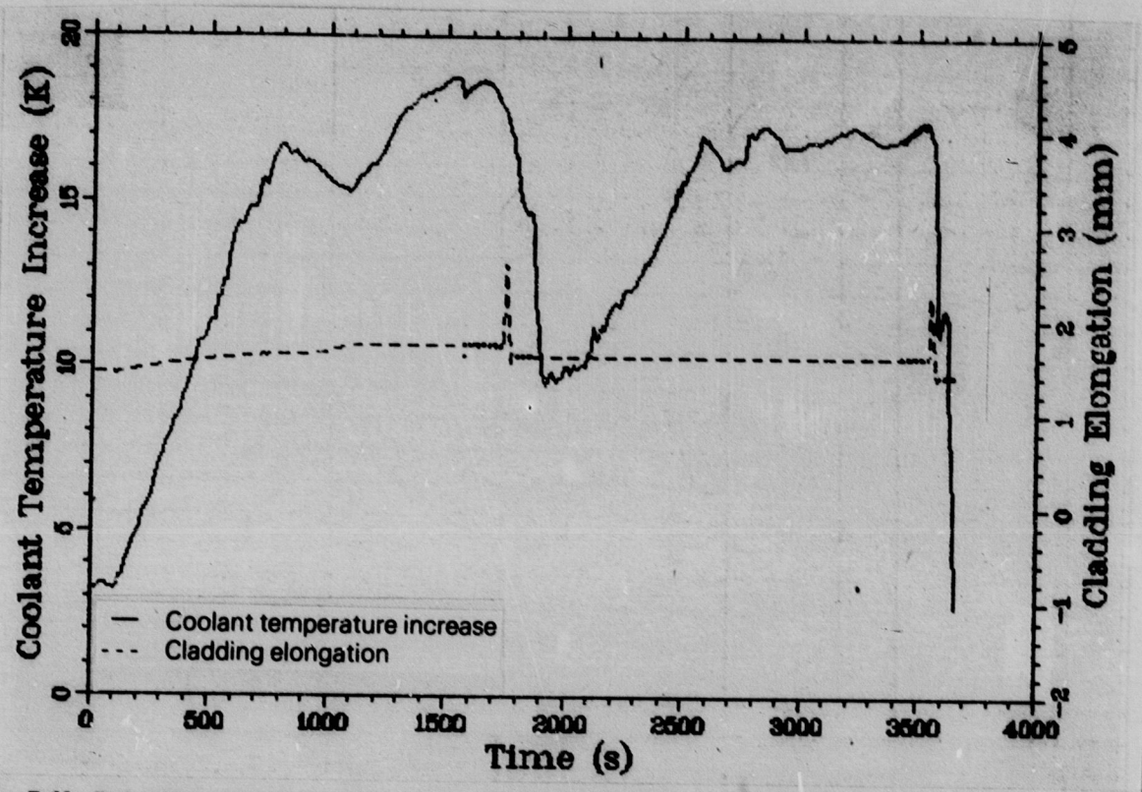


Fig. D-92 Rod A-0015 coolant temperature increase and cladding elongation histories during Test PCM-3 DNB Cycles 3 and 4.

DNB CYCLE FIVE

Zero time corresponds to Test IRIG time 00:14, June 26, 1976.

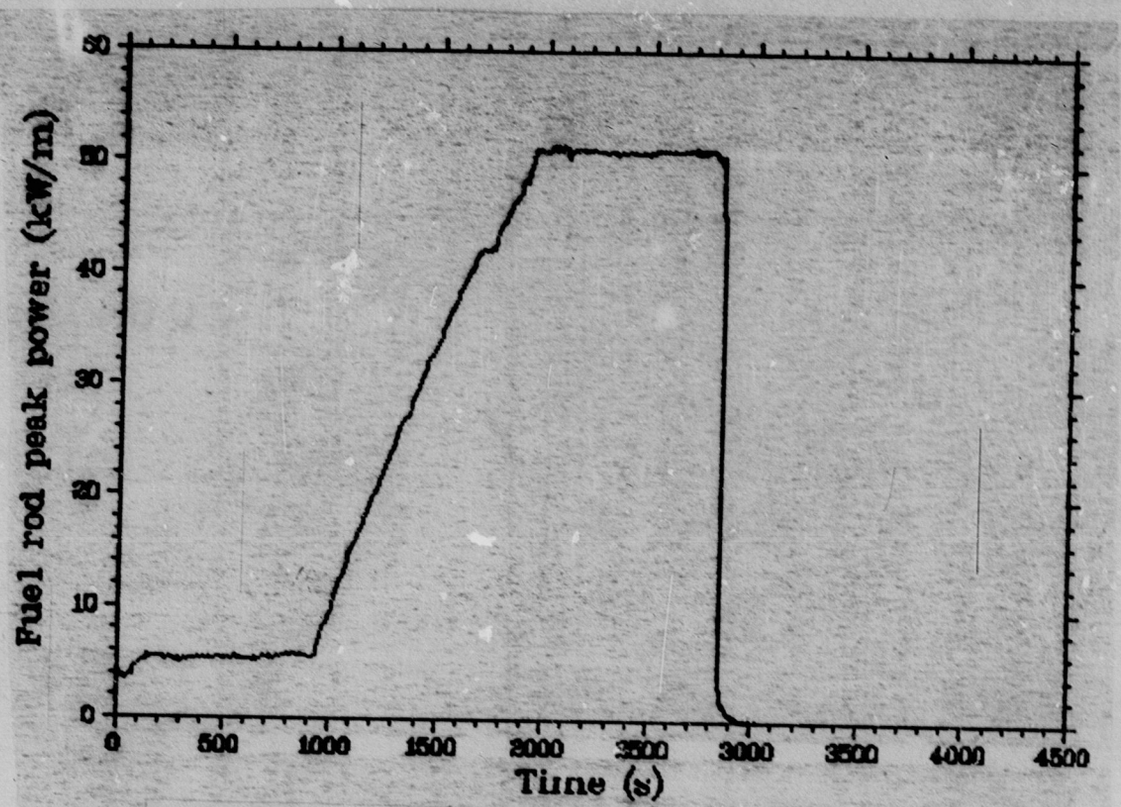


Fig. D-93 Fuel rod peak power time history during Test PCM-3 DNB Cycle 5.

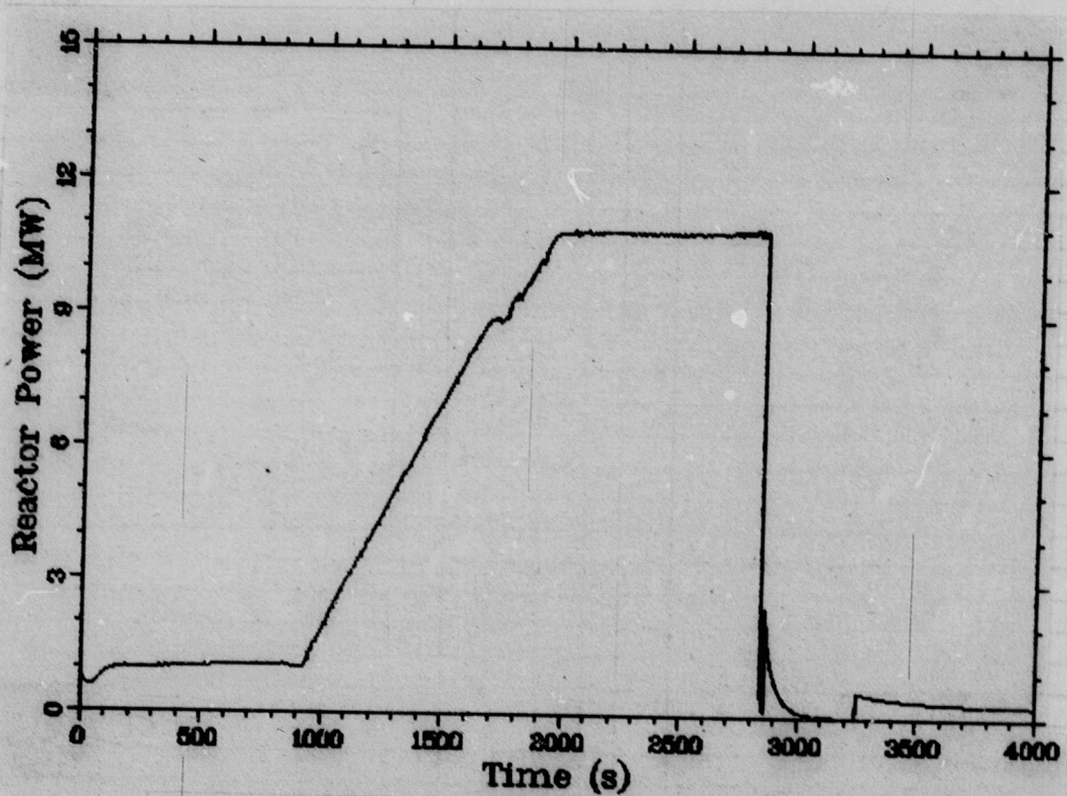


Fig. D-94 PBF core power time history during Test PCM-3 DNB Cycle 5.

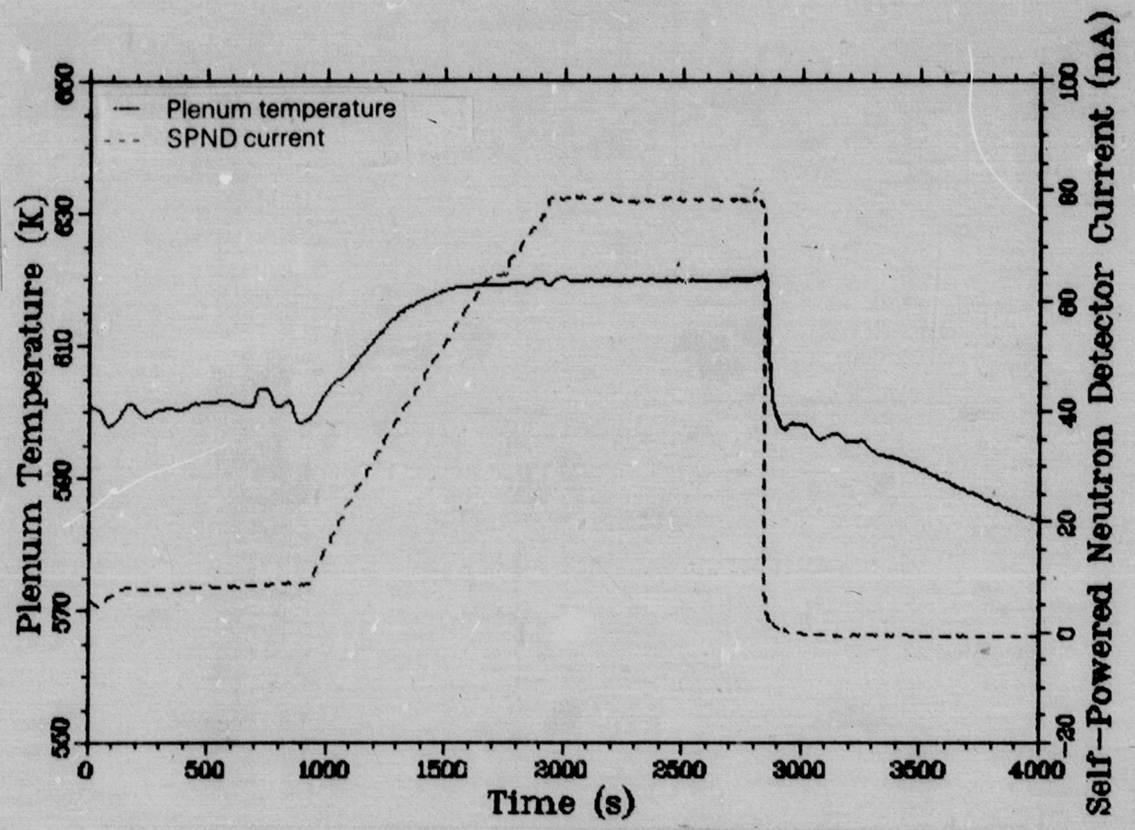


Fig. D-95 Plenum temperature and SPND current at 0.31-m elevation histories during Test PCM-3 DNB Cycle 5.

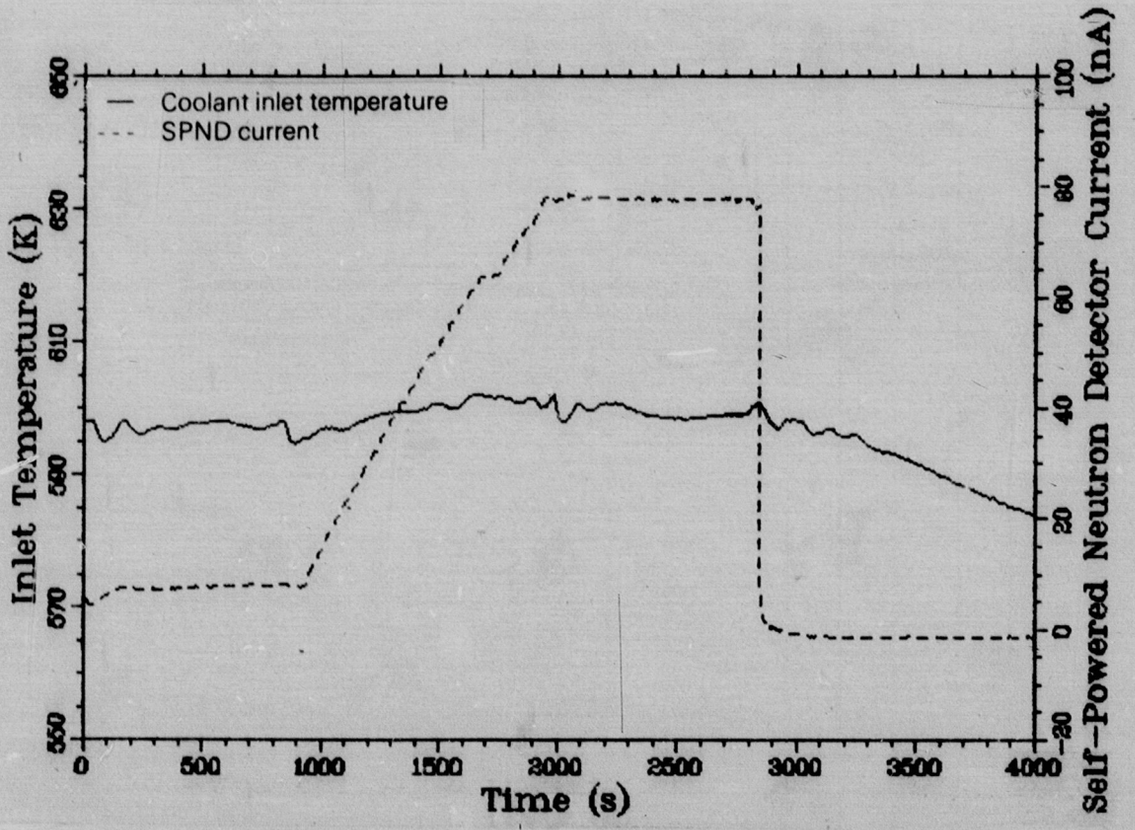


Fig. D-96 Coolant inlet temperature No. 1 and SPND current at 0.47-m elevation histories during Test PCM-3 DNB Cycle 5.

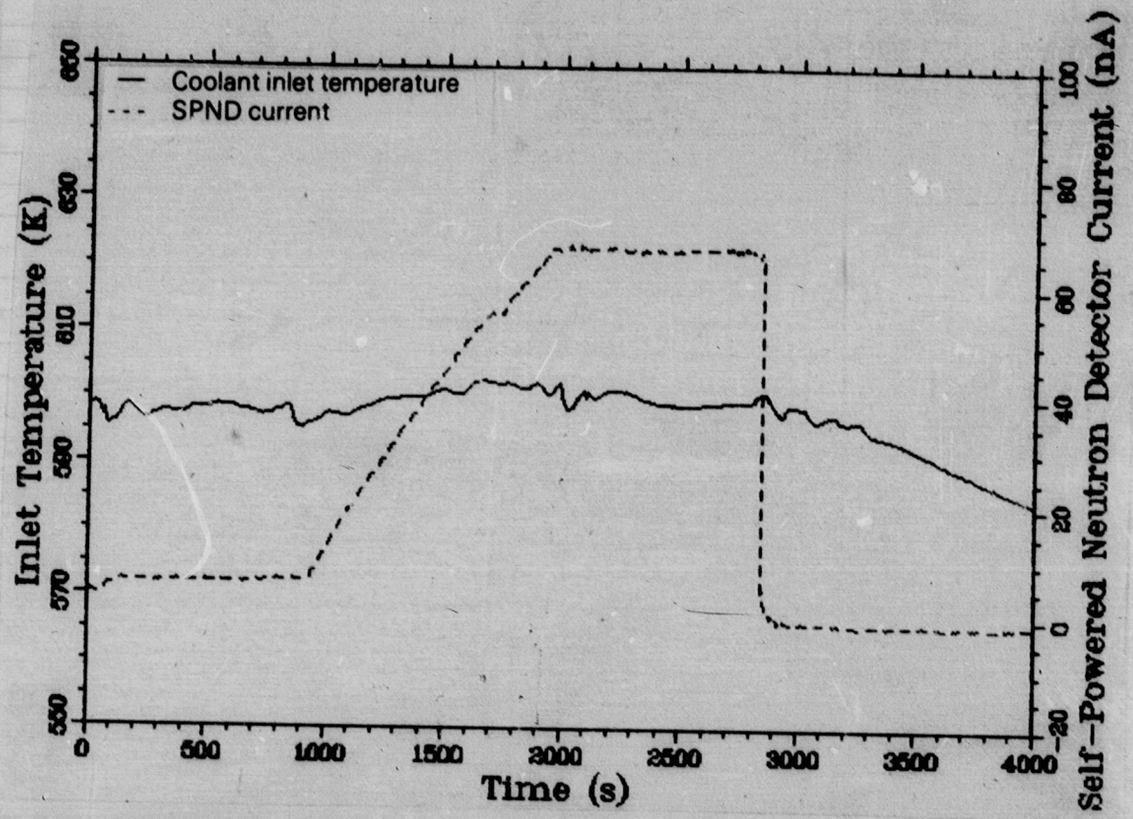


Fig. D-97 Coolant inlet temperature No. 2 and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 5.

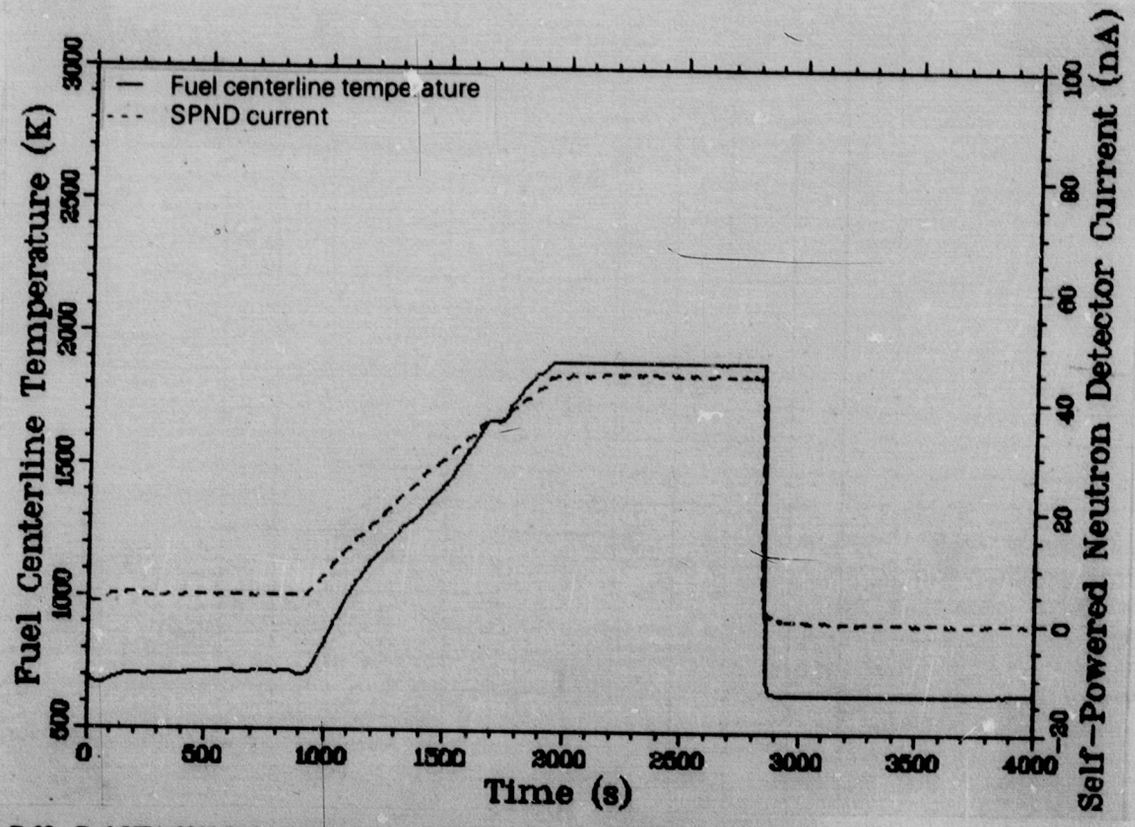


Fig. D-98 Rod UTA-0011 fuel centerline temperature and SPND current at 0.78-m elevation histories during Test PCM-3 DNB Cycle 5.

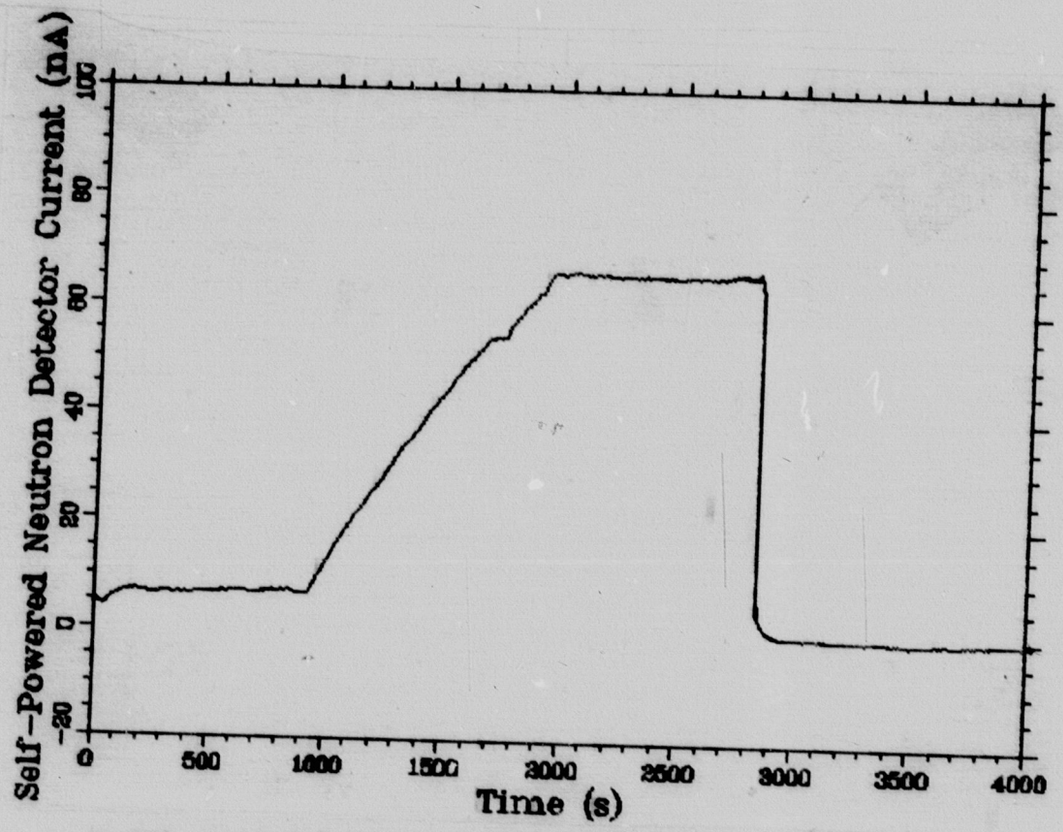


Fig. D-99 Rod UTA-0013 SPND current at 0.63-m elevation history during Test PCM-3 DNB Cycle 5.

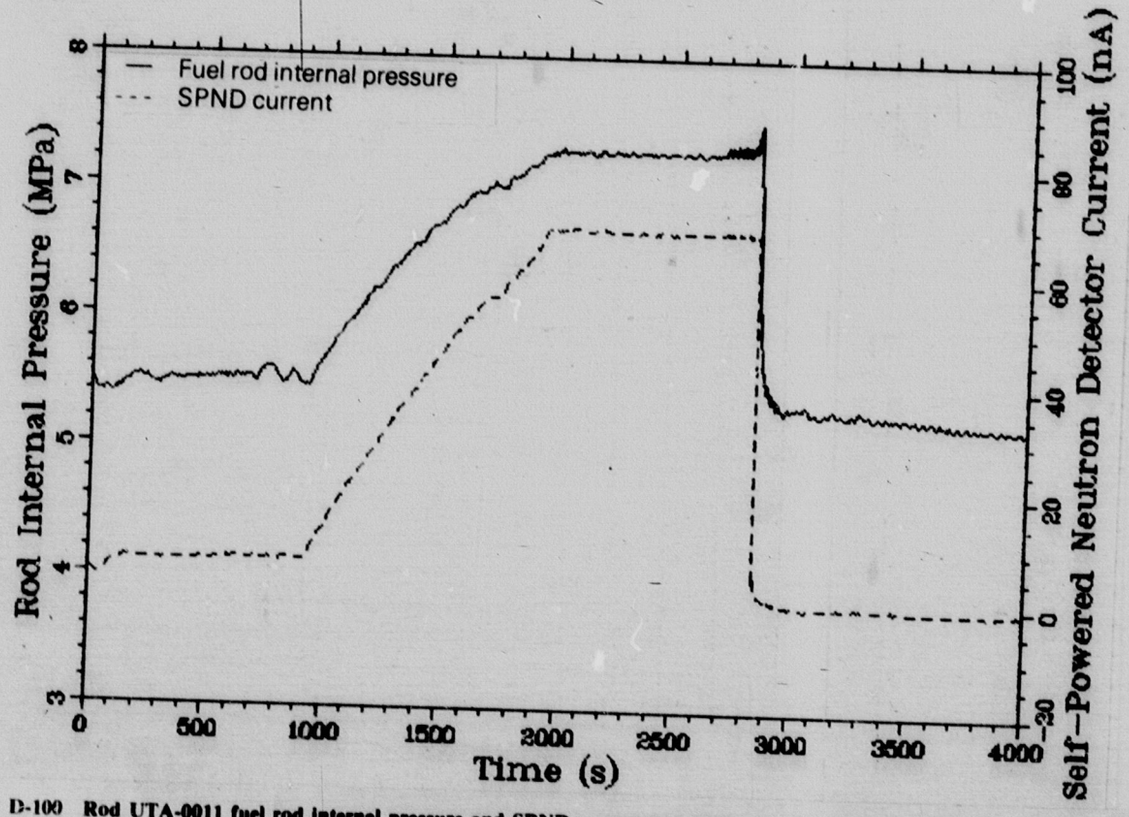


Fig. D-100 Rod UTA-0011 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 5.

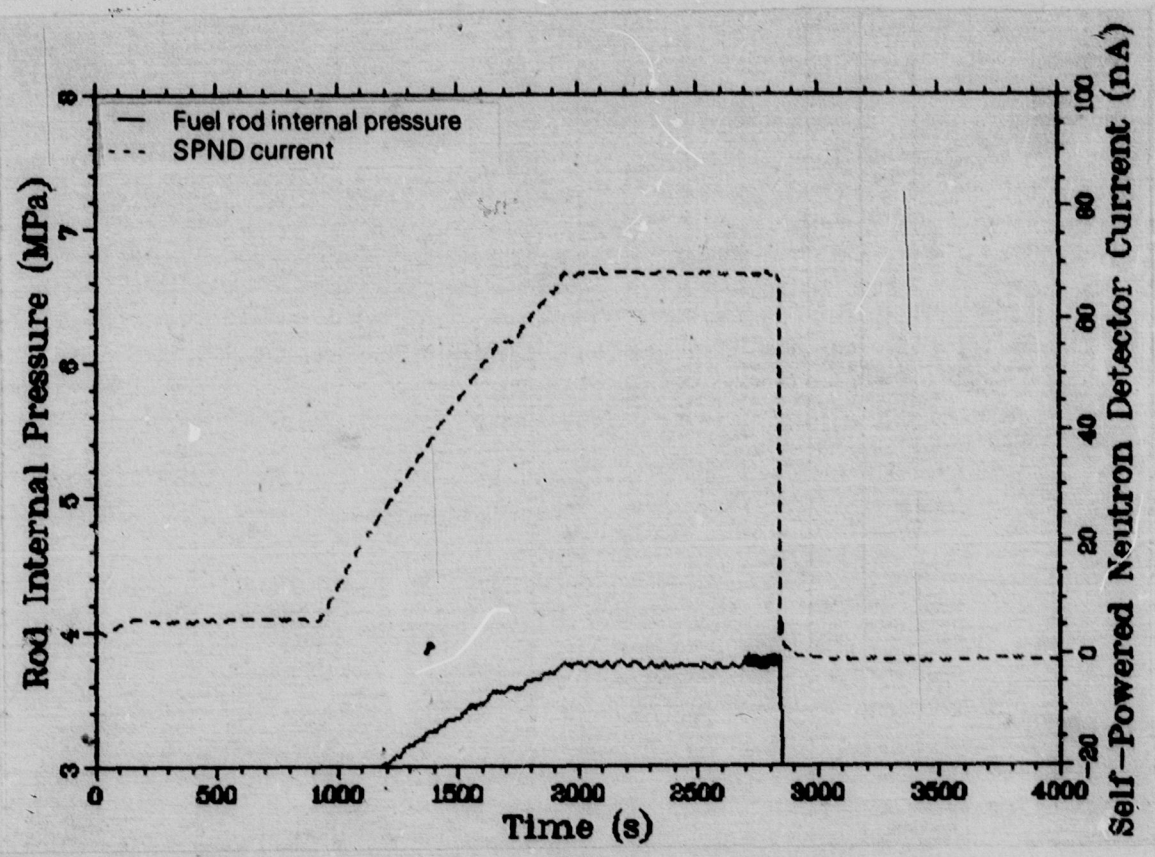


Fig. D-101 Rod UTA-0013 fuel rod internal pressure and SPND current at 0.63-m elevation histories during Test PCM-3 DNB Cycle 5.

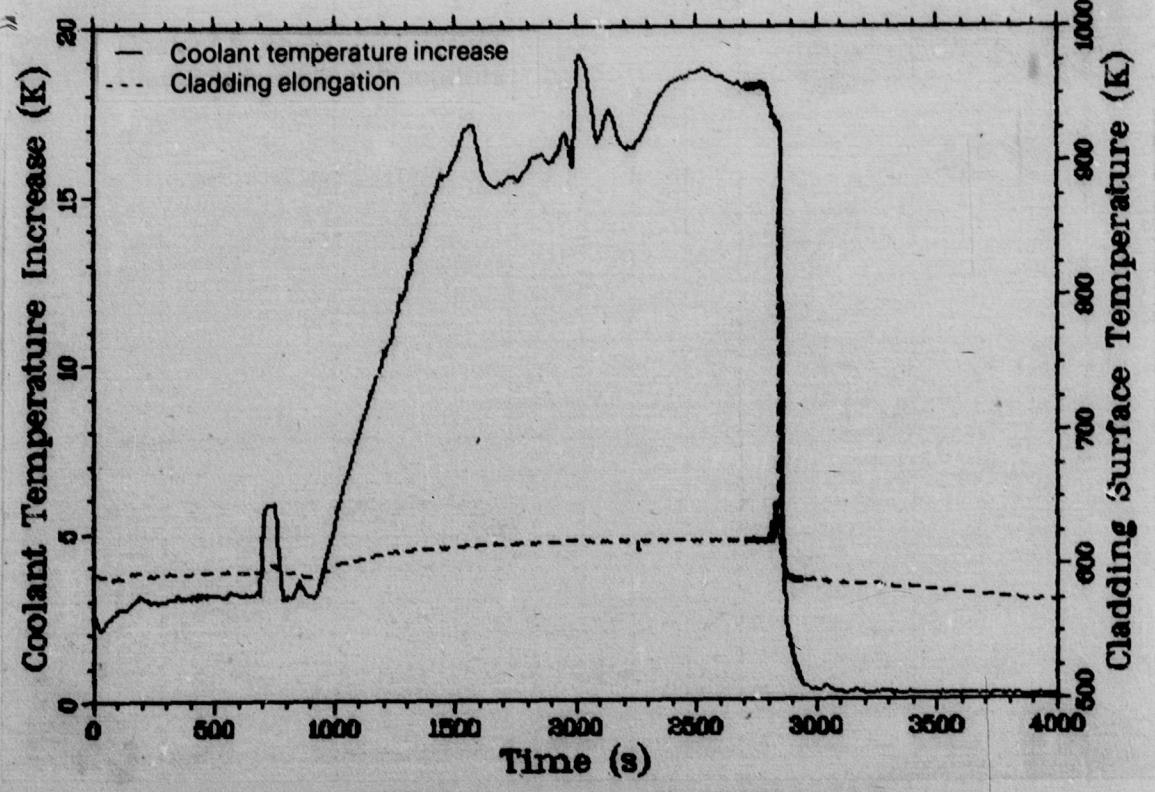


Fig. D-102 Rod UTA-0011 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 5.

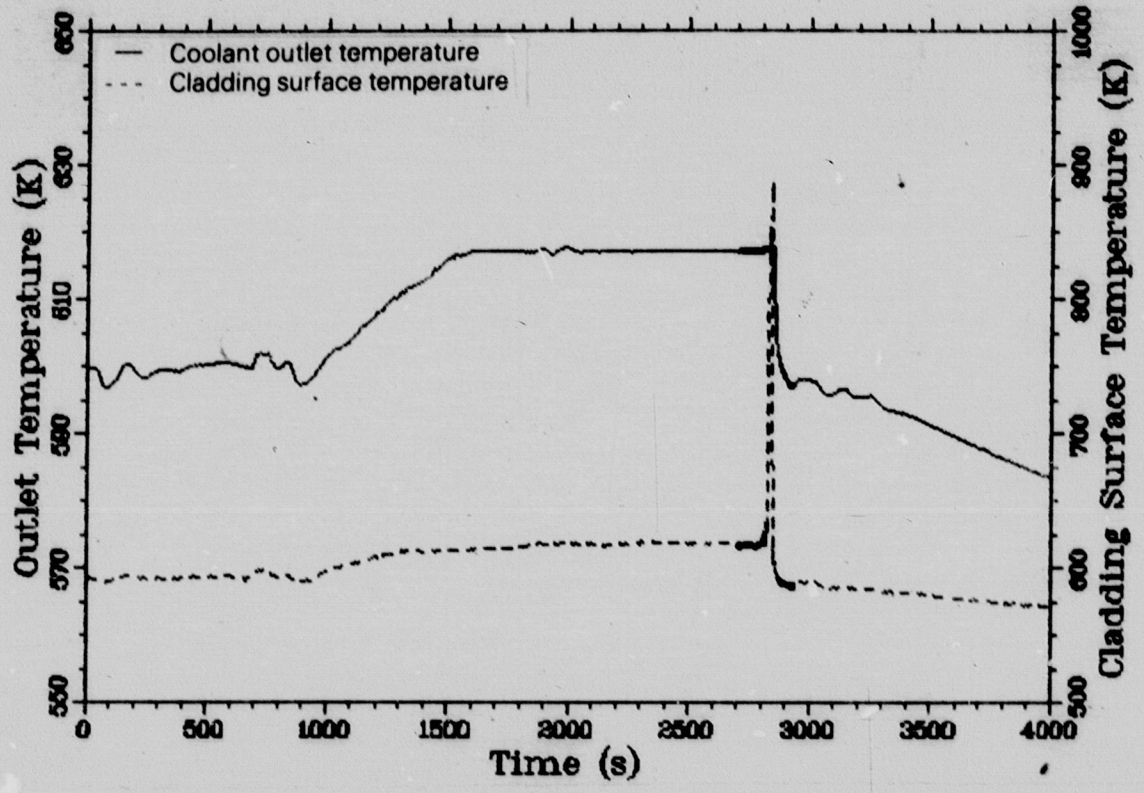


Fig. D-103 Rod UTA-0011 coolant outlet temperature and cladding surface temperature at 0.74-m and 90-degree location histories during Test PCM-3 DNB Cycle 5.

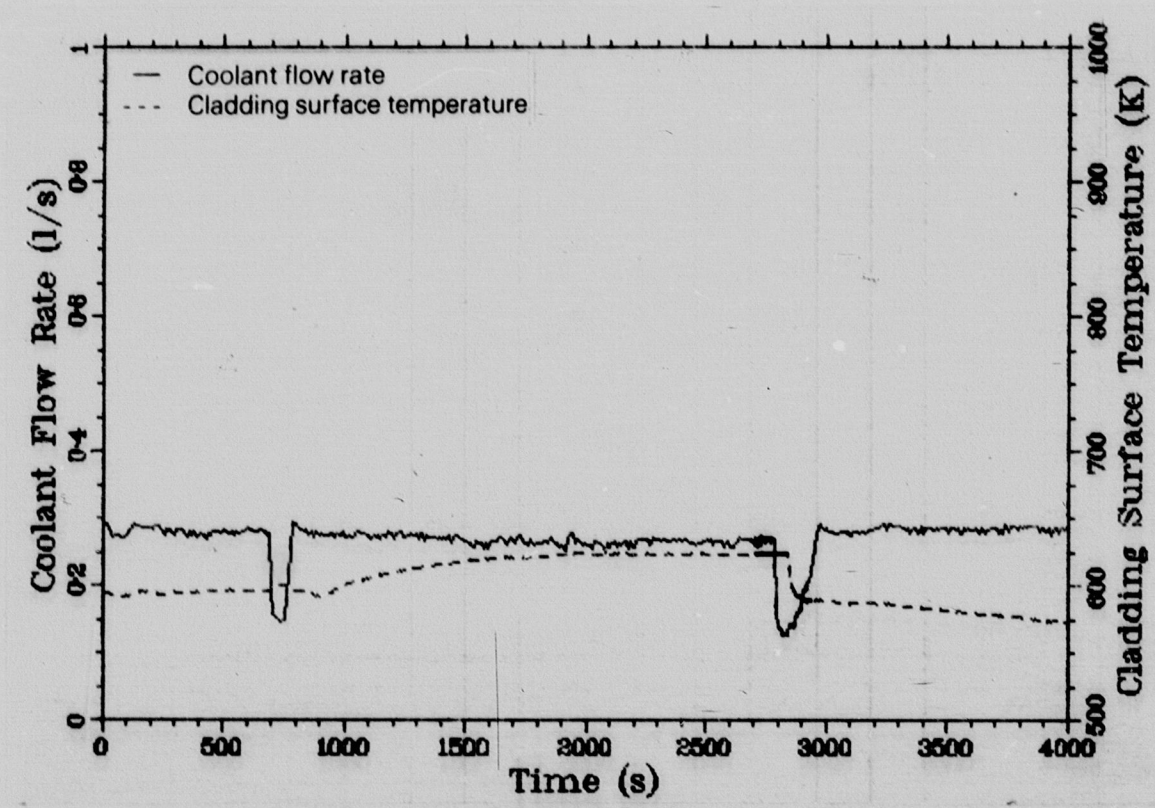


Fig. D-104 Rod UTA-0011 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 5.

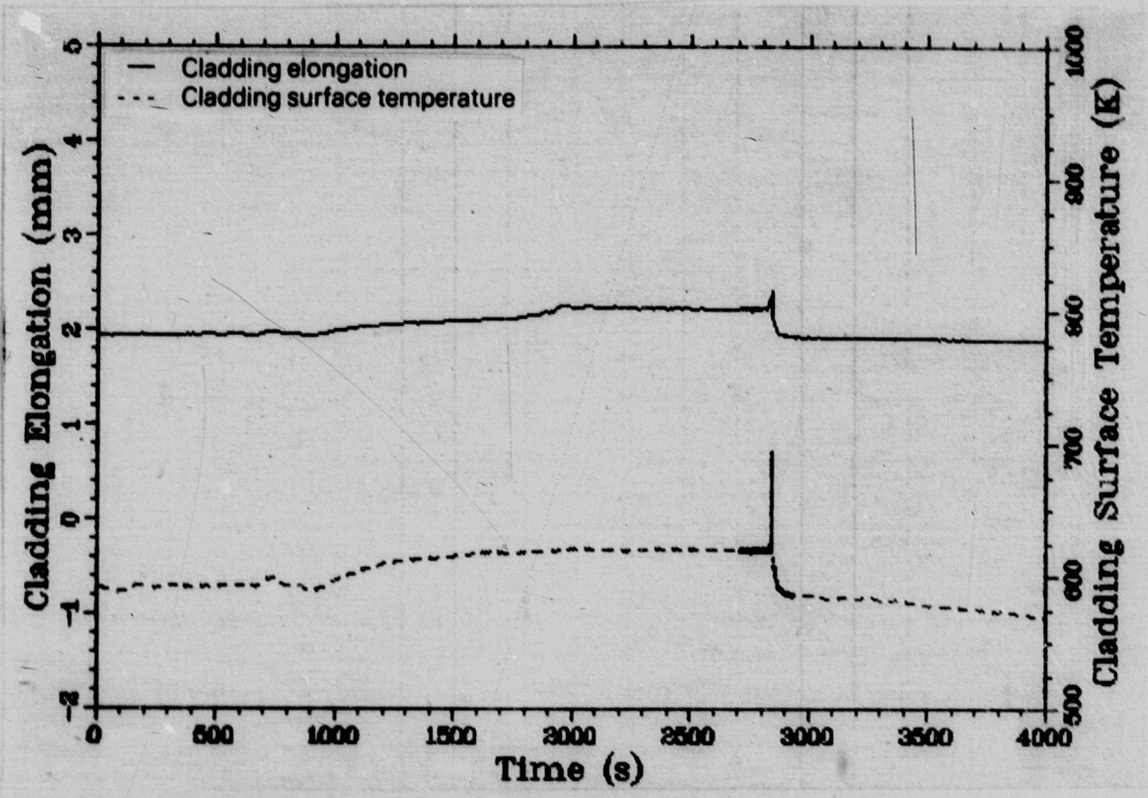


Fig. D-105 Rod UTA-0011 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 5.

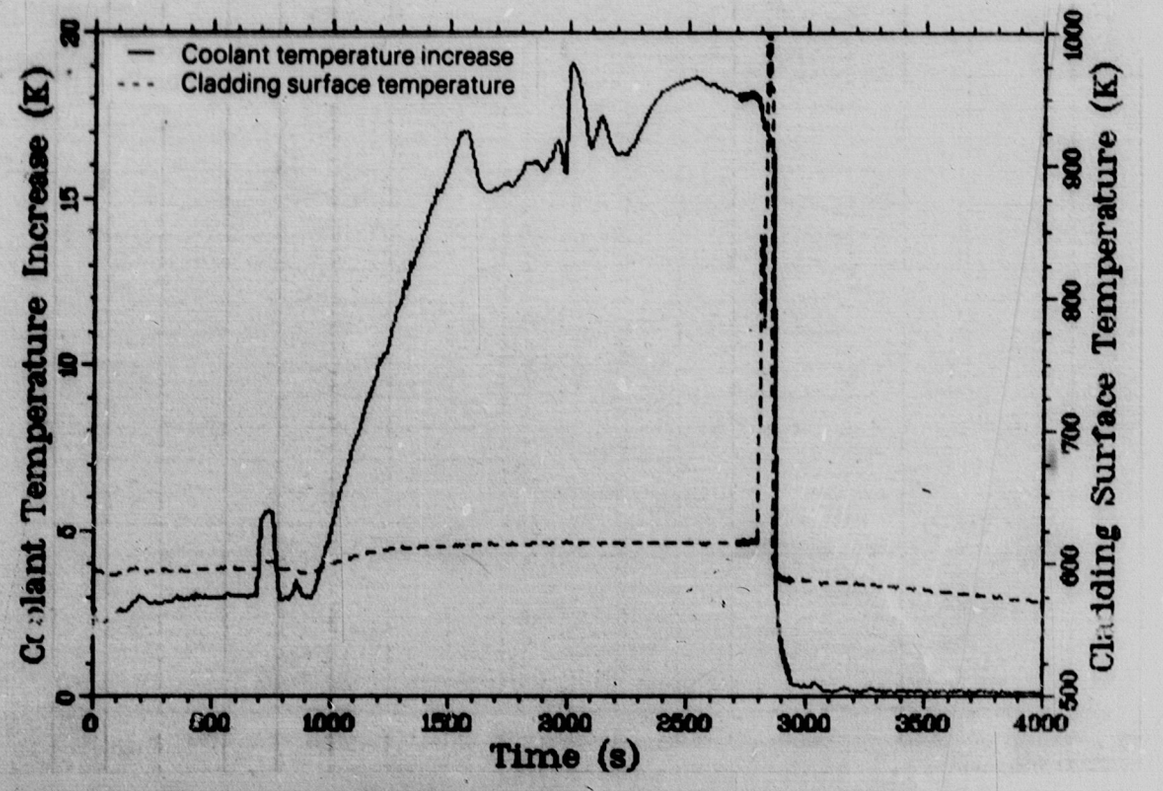


Fig. D-106 Rod A-0021 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degree location histories during Test PCM-3 DNB Cycle 5.

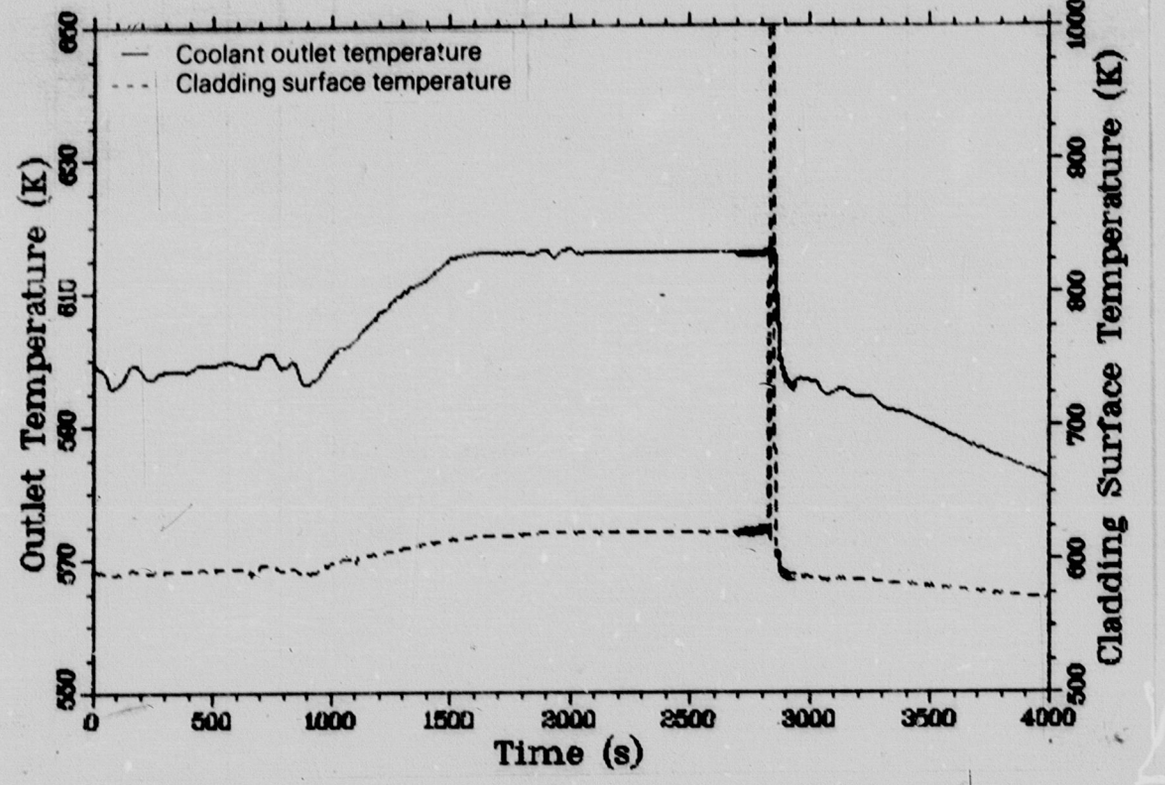


Fig. D-107 Rod A-0021 coolant outlet temperature and cladding surface temperature at 0.69-m and 90-degree location histories during Test PCM-3 DNB Cycle 5.

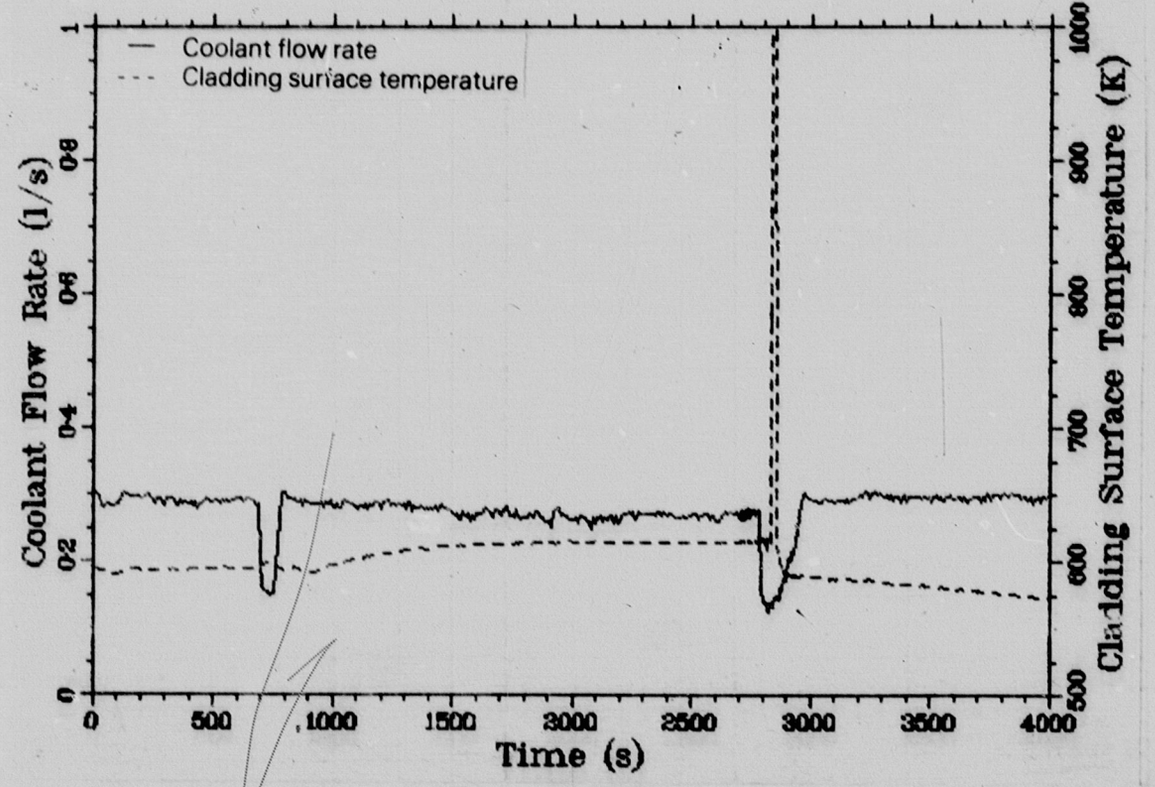


Fig. D-108 Rod A-0021 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 5.

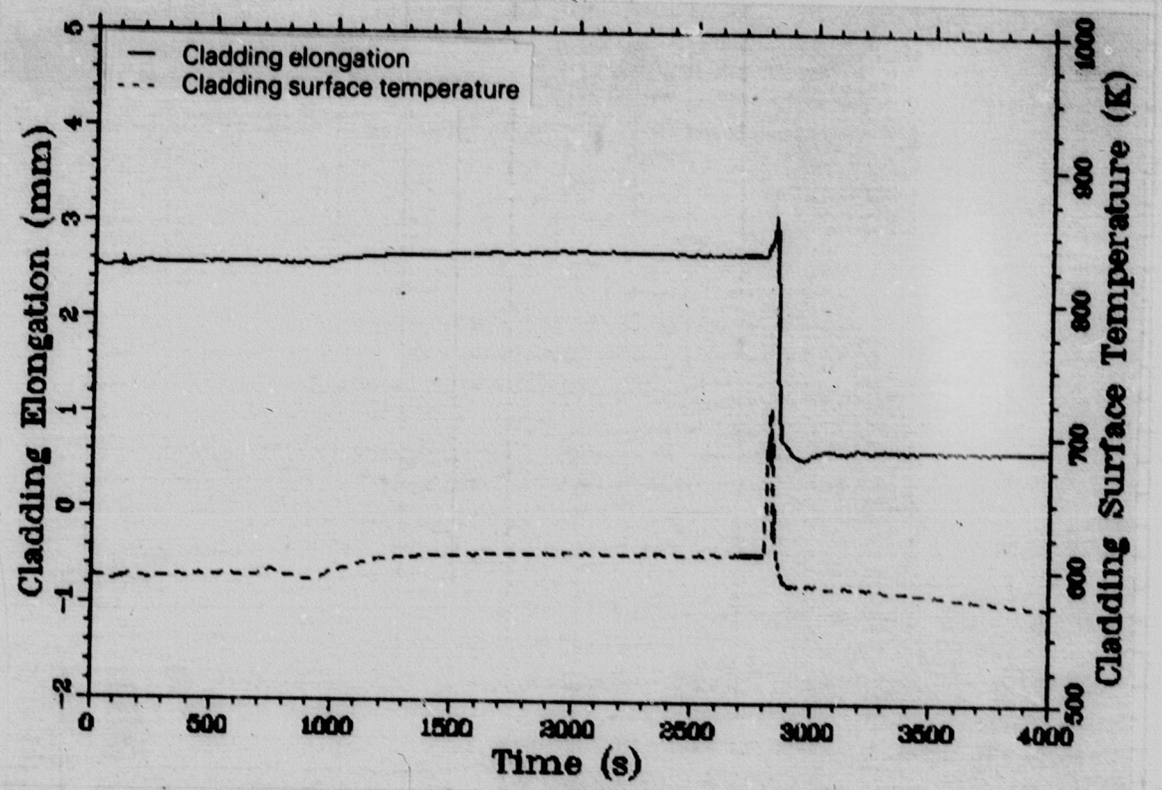


Fig. D-109 Rod A-0021 cladding elongation and cladding surface temperature at 0.89-m and 270-degree location histories during Test PCM-3 DNB Cycle 5.

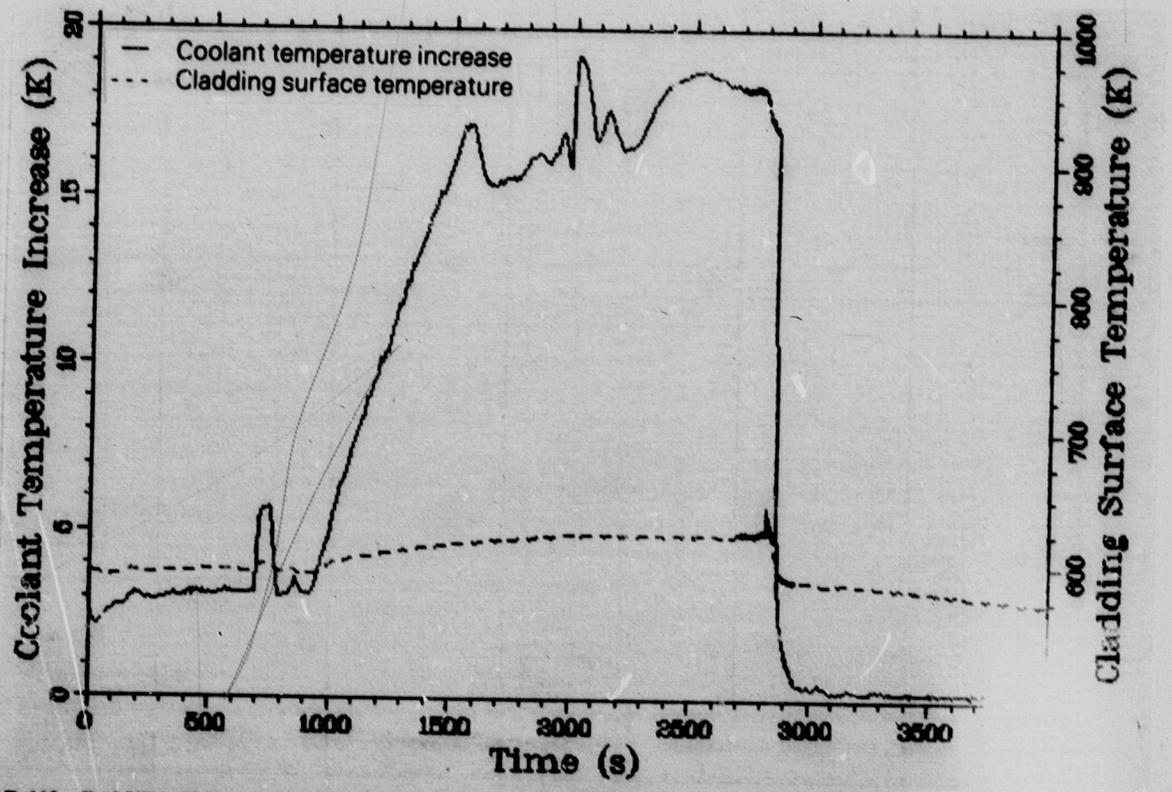


Fig. D-110 Rod UTA-0013 coolant temperature increase and cladding surface temperature at 0.69-m and 0-degr istories during Test PCM-3 DNB Cycle 5.

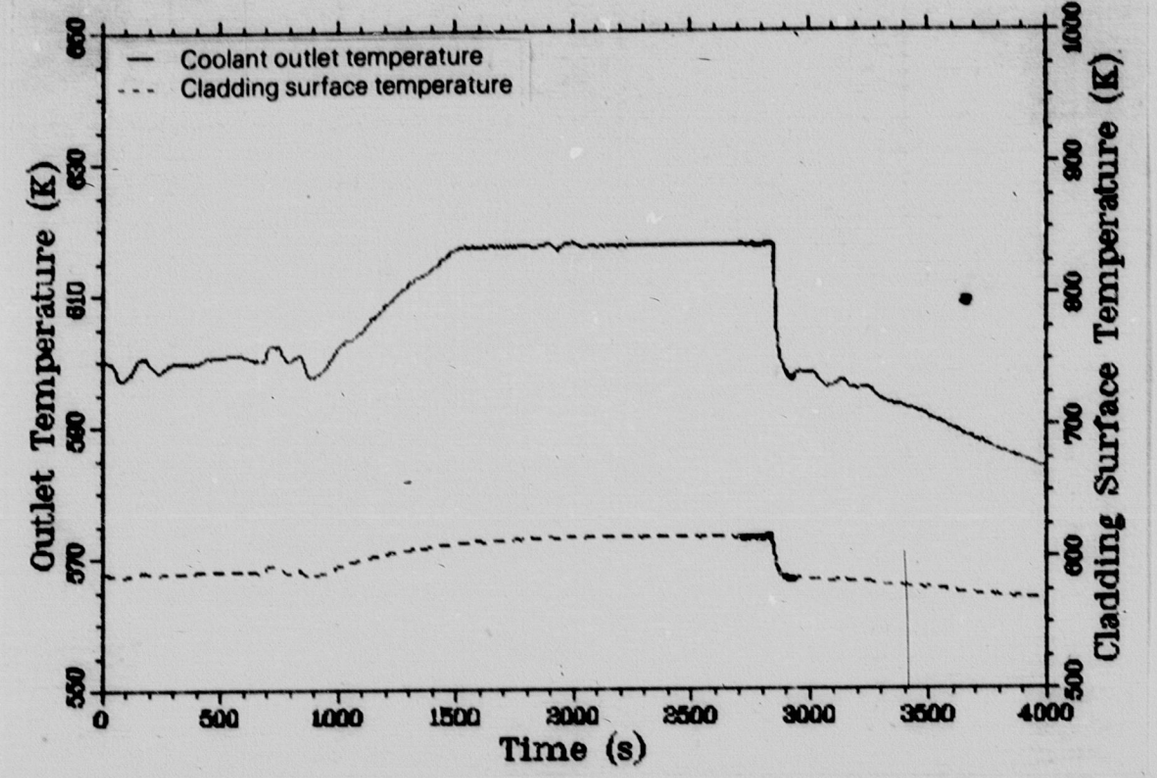


Fig. D-111 Rod UTA-0013 coolant outlet temperature and cladding surface temperature at 0.48-m and 90-degree location histories during Test PCM-3 DNB Cycle 5.

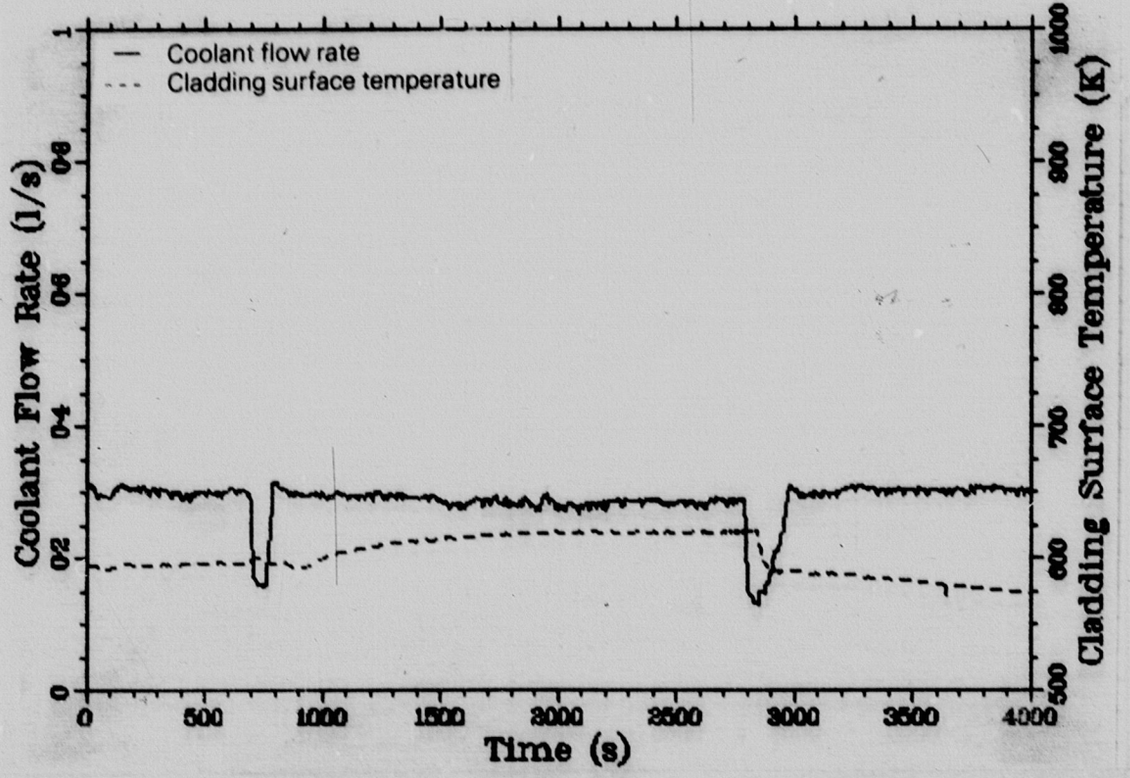


Fig. D-112 Rod UTA-0013 coolant flow rate and cladding surface temperature at 0.58-m and 180-degree location histories during Test PCM-3 DNB Cycle 5.

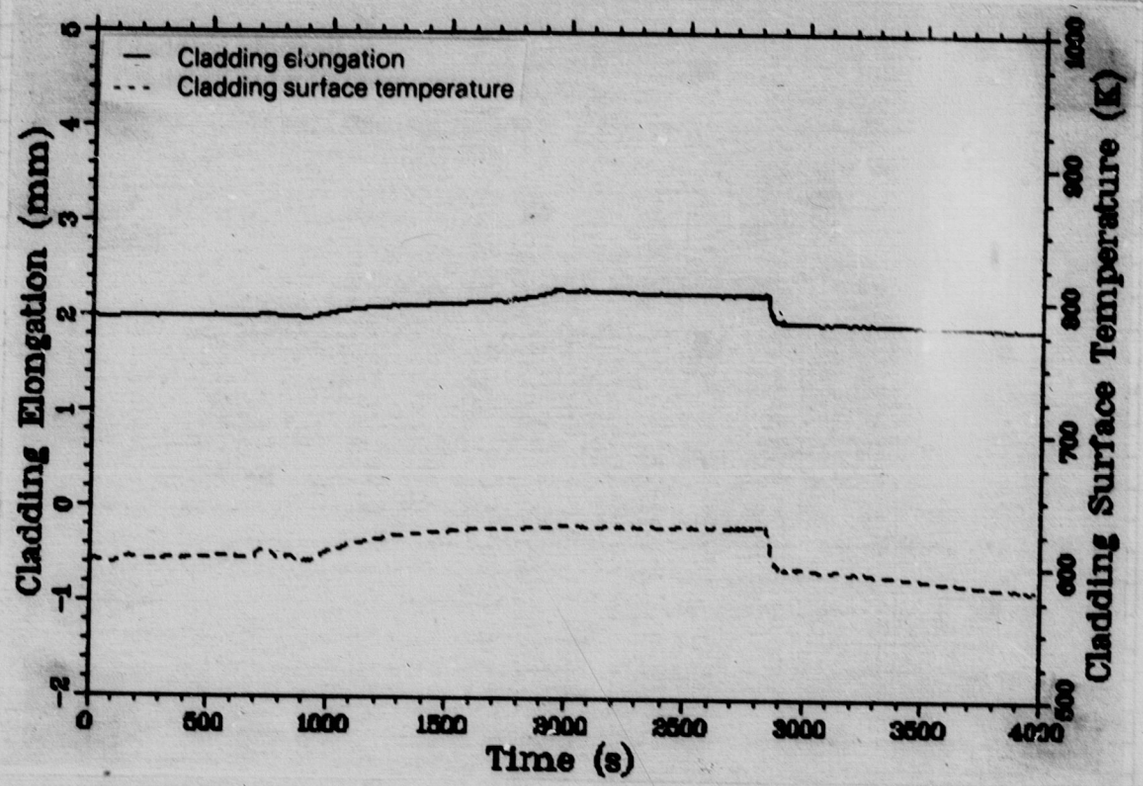


Fig. D-113 Rod UTA-0013 cladding elongation and cladding surface temperature at 0.63-m and 270-degree location histories during Test PCM-3 DNB Cycle 5.

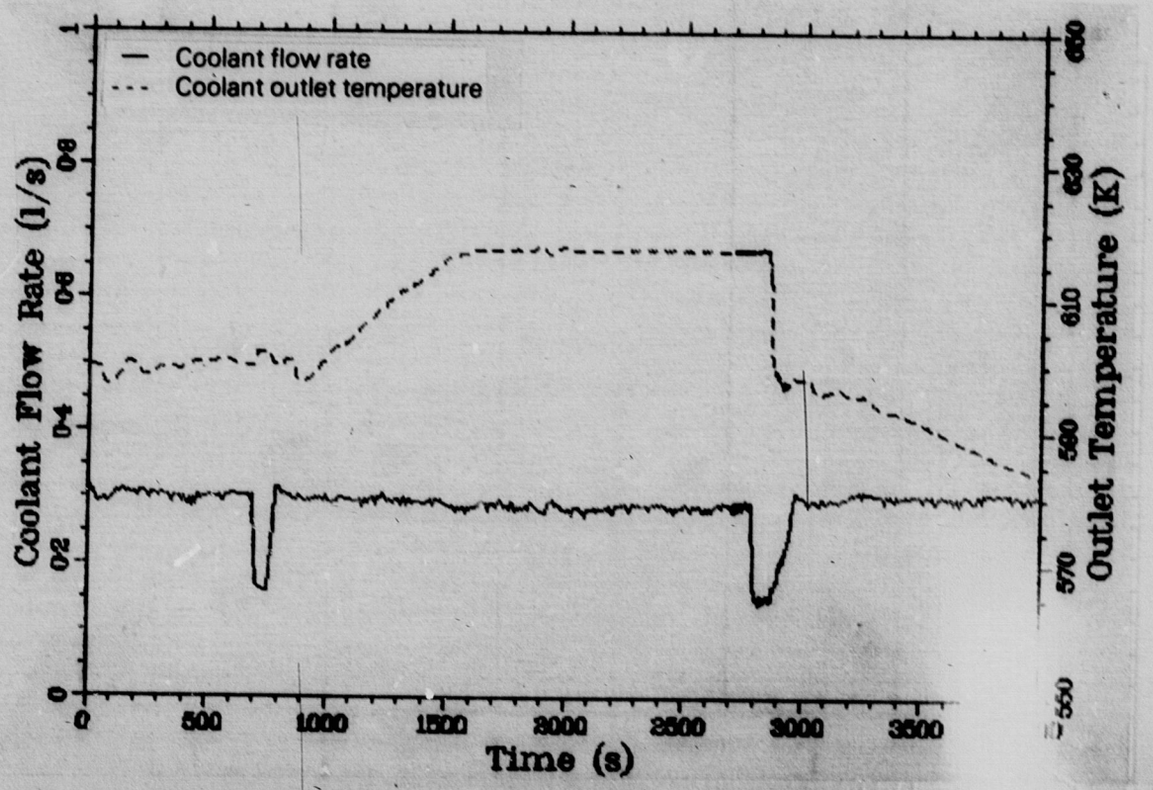


Fig. D-114 Rod A-0015 coolant flow rate and coolant outlet temperature histories during Test PCM-3 DNB Cycle 5.

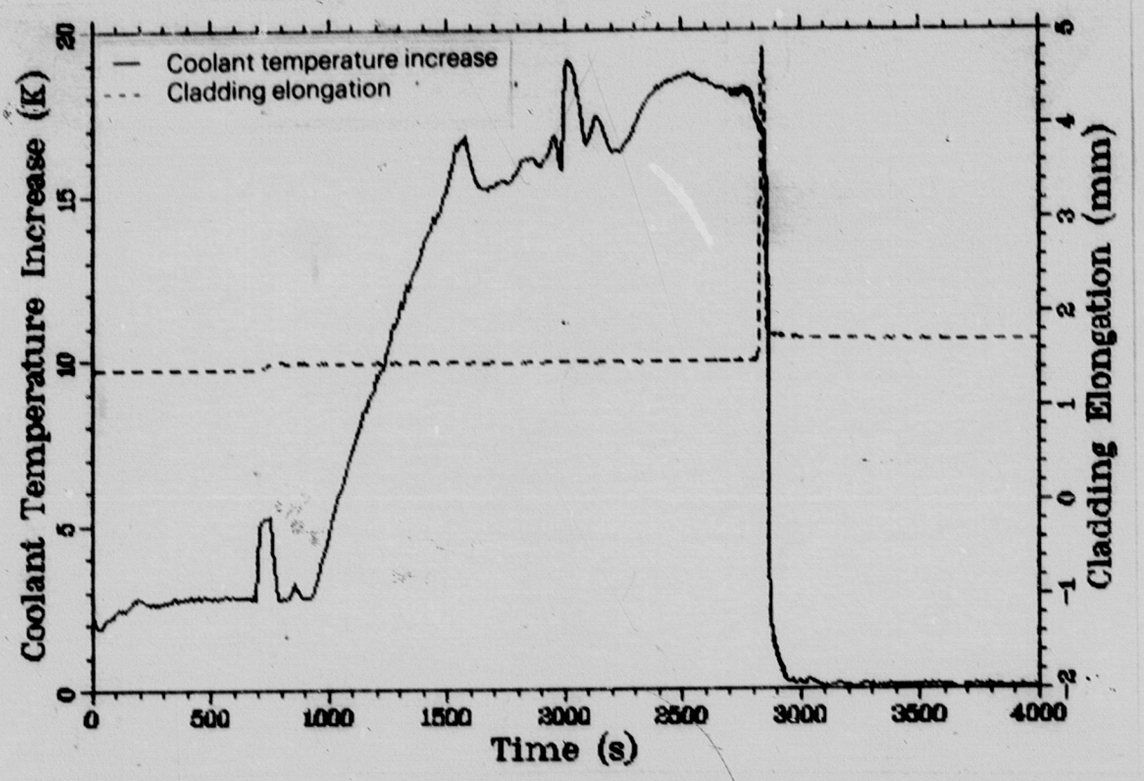


Fig. D-115 Rod A-0015 coolant temperature increase and cladding elongation histories during Test PCM-3 DNB Cycle 5.