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OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT JANUARY, FEBRUARY, AND MARCH OF 1973

S. S. Hurt, III

E. D. Lance

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OPERATIONS DIVISION

OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT

JANUARY, FEBRUARY, AND MARCH OF 1973

S. S. Hurt, III

E. D. Lance

SEPTEMBER 1973

NOTICE This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

OAK RIDGE NATIONAL LABORATORY
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SUMMARY

The ORR operated at an average power level of 29.9 Mw for 89.3% of the time during January, February, and March of 1973. Thirty-seven fuel elements were declared spent with an average burnup of 47.2%, and two shim-rod elements were retired from service at an average burnup of 90.1%.

The reactor was shut down on eight occasions, all of which were scheduled. End-of-cycle shutdowns accounted for 91.3% of the total downtime, with the remainder used principally for refueling and experiment work.

Maintenance activities, both mechanical and instrument, were essentially routine in nature.

The reactivity worths of the shim rods were measured because of a change in the schedule for shim-rod utilization.

OPERATIONS

Basic operating data for the quarter is compared with similar data from recent experience in Table 1. The minor variations apparent reflect only expected changes due to the operating schedule with very stable overall operation indicated. The quarter included portions of operating cycles 109 and 111, and all of cycle 110 as indicated in Table 2.

Table 1. ORR Basic Operating Data
January, February, and March of 1973

	This Quarter	Last Quarter	Year To Date	January, February and March of 1972
Total energy, Mwd	2,402.11	2539.58	2,402.11	2,550.6
Average power, Mw/operating hr	29.9	29.9	29.9	30.0
Time operating, %	89.3	92.2	89.3	93.6
Availability, %	91.6	93.3	91.6	95.9
Reactor water radioactivity, $\frac{c/min}{ml}$ (av)	31,300	31,100	31,300	29,300
Pool water radioactivity, $\frac{c/min}{ml}$ (av)	660	618	660	588
Reactor water resistivity, ohm-cm (av)	795,000	789,000	795,000	859,000
Pool water resistivity, ohm-cm (av)	947,000	896,000	947,000	525,000
Fuel elements depleted	37	37	37	27
Average burnup of fuel elements depleted, %	47.2	47.2	47.2	52.1
Shim rods depleted	2	1	2	1
Average burnup of shim rods depleted, %	90.1	89.2	90.1	83.7
Radioisotope samples	0	3	0	17
Research samples	5	13	5	7

Table 2. Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (Mwd)
109	October 9, 1972	January 7, 1973	1,684.15*
110	January 12, 1973	February 25, 1973	1,304.79
111	March 1, 1973	In progress	901.45

*195.87 Mwd accumulated this quarter.

FUEL USAGE AND INVENTORY

Twenty-four new fuel elements were placed in service during the quarter, and thirty-seven were declared spent. The average percent burnup of the elements declared spent was 47.0. Two shim rods were declared spent with an average burnup of 90.1%.

The supply of new fuel elements has been reduced to only twenty-seven elements, four of which are partial elements; however, fuel elements being fabricated are expected to be available very soon.

Other details of fuel usage and inventory may be found in Tables 1 and 3.

Table 3. ORR Fuel Status

	This Quarter	Last Quarter	Year To Date	Jan. through March, 1972
Depleted fuel elements transferred for chemical separation	26	12	26	24
Average percent burnup of fuel elements transferred	47.0	53.0	47.0	53.3
New fuel elements placed in service	24	25	24	34
New fuel elements available for use	27*	51		
Depleted shim rods transferred for chemical separation	2	2	2	4
Average percent burnup of shim rods transferred	88.8	86.3	88.8	69.9
New shim rods places in service	2	1	2	1
New shim rods available for use	2	4		
New shim-rod fuel assemblies available for use	0	0		

*Includes four partial fuel elements.

SHUTDOWNS AND POWER REDUCTIONS

The shutdowns which occurred during the quarter are summarized in Table 4, where it is made readily apparent that there were no unscheduled shutdowns. Details of the scheduled shutdowns are presented in Table 5.

Table 4. Summary of Shutdowns

Description of Shutdown	Number	Downtime (hr)
Scheduled		
Regular, end of cycle	2	211.567
Regular, refueling	2	7.684
Special, refueling and iodine removal	4	12.583
Subtotal	8	231.834
Unscheduled		
Subtotal	0	
Total	8	231.834

Table 5. ORR Scheduled Shutdowns, Details

Date	Duration (hr)	End Cycle	Remarks
1-2-73	2.983	109G	The reactor was refueled and isotope (iodine, xenon) work was completed.
1-7-73	118.967	109	This shutdown terminated operating cycle 109. Maintenance work included the following: replacement of servo relays 13X and 14X; replacement of the No. 2 shim-rod seat switch; modification of the Nos. 1 and 2 Log-N amplifiers (see Reactor Change Memo No. 106); replacement of the muffler on the diesel generator; replacement of the reactor tank access cover gasket; completion of all routine maintenance work; replacement of the No. 6 shim-rod motor; and the beginning of X-raying the primary water lines at the pump house. Experiment work included pressure testing of the GB-10 experiment and preinstallation work continued on the future HTGR experiment.
1-30-73	3.067	110A	The reactor was refueled and isotope (iodine, xenon) work was completed.
2-13-73	3.433	110B	The reactor was refueled and isotope (iodine, xenon) work was completed.
2-22-73	2.817	110C	The reactor was refueled.
2-25-73	92.600	110	This shutdown terminated operating cycle 110. Maintenance work included the following: replacement of the No. 3 shim-rod operator assembly; replacement of the No. 1 Log-N recorder amplifier, balance motor, and the zener power supply; replacement of the counting-rate voltage supply on the No. 2 counting-rate channel; replacement of the balance motor on the south ^{16}N recorder; replacement of the safety sigma amplifier on the No. 2 safety channel; replacement of the two faulty steam coils on the ORR control room heating and ventilation unit; replacement of pressure-relief valves on all beam holes, HN-1, and HN-4; continuation of X-raying welds in the primary water lines at the pump house; and completion of all routine maintenance work. Experimental work included testing of the GB-10 experiment and installing new piping for the new OF-1 experiment.

Table 5. (Continued)

Date	Duration (hr)	End Cycle	Remarks
3-15-73	4.867	111A	The reactor was refueled.
3-28-73	3.100	111B	The reactor was refueled and isotope (iodine, xenon) work was completed.

INSTRUMENTATION AND REACTOR CONTROLS

Instrument changes or repairs required during the quarter are listed in Table 6.

Reactor Instrument and Controls Design Change Memo No. ORR-106 authorized the installation of a current-adder circuit to the Log-N amplifier, thereby providing a small continuous current flow to the logarithmic diode circuit to offset any effects of overcompensation of the chamber.

Reactor Instrument and Controls Design Change Memo No. ORR-107 authorized the replacement of the capacitor, No. C7, in the fission chamber preamplifier to stabilize the preamplifier gain.

The status of the active and spare ionization and fission chambers is given in Table 7.

PROCESS SYSTEMS AND MECHANICAL COMPONENTS

Details of maintenance or changes to the process system are given in Table 8, while Table 9 lists the maintenance on the mechanical components. Table 10 summarizes the results of efficiency tests of the various gaseous waste filters.

EXPERIMENT FACILITIES AND CORE CHANGES

Experiment facility assignments are listed in Table 11, while facility usage is given in Table 12. The core configuration used during the quarter is shown in Figure 1.

ORR LATTICE LOADING

For Fuel Cycles 109G, 109E, 110A through 110D, 111A, and 111B

	1	2	3	4	5	6	7	8	9
A	Be	Be	Fuel	Fuel	Fuel	Fuel	Be	Be	E
B	Be	Be	Fuel	SR	Fuel	SR	Fuel	E	E
C	E	Be	Fuel	Fuel	Fuel	Fuel	Fuel	Be	Be
D	Be	Be	Fuel	SR	Fuel	SR	Fuel	HT	Be
E	Be	^{131}I	Fuel	Fuel	Fuel	Fuel	Fuel	Be	Be
F	Be	Be	Fuel	SR	Fuel	SR	Fuel	Be	E
G	Be	Be	Be	Be	Be	Be	Be	Be	Be

LATTICE COMPONENT	NUMBER
Fuel	23
Shim Rod (SR)	6
Beryllium (Be)	27
Experiment (E)	5
Iodine Sleeve (^{131}I)	1
Isotope Stringer (Iso)	0
Hydraulic Tube (HT)	1

Fig. 1. ORR Lattice Configuration January 1 through 7, 1973; January 12, 1973 through February 25, 1973; and March 1 through 31, 1973

PROCEDURE ADDITIONS OR REVISIONS

Changes which were made to the ORR operating manual during the quarter are listed in Table 13.

SPECIAL TEST

Shim-Rod Calibration

All six shim rods were calibrated at the beginning of cycle 110A (January 11, 1973) as reported in Appendix A.

UNUSUAL OCCURRENCES

Leaking Fuel Element, February 3-12, 1973

The radioactivity of the reactor water increased to ∿120% of normal during fuel cycle 110B, thereby indicating a leaking fuel element.

Operation was continued, with special checks on radioactivity, until the scheduled refueling shutdown on February 13, 1973, at which time the "leaker" was identified as element OR-72P. This fuel assembly (the ^{235}U reduced to 150 g) was placed in a hooded single-place rack for decay prior to shipment for reprocessing.

Table 6. Maintenance and Changes, Instrumentation and Controls

Date	Component	Trouble or Change	Reason or Maintenance
		No. 1 Counting-Rate Channel	
			No maintenance or changes were required.
		No. 2 Counting-Rate Channel	
1-26-73	Counting-rate recorder	Erratic readout	The trouble was corrected after the slide wire was replaced.
2-26-73	Counting-rate voltage supply	Replacement (Routine maintenance)	The voltage supply was replaced because the one in use would not meet calibration specifications.
3-5-73	Counting-rate recorder	Loose chart pickup reel	The pickup reel was tightened.
3-6-73	Counting-rate pre-amplifier	Capacitor change	The gain on the counting-rate channel preamplifier was stabilized (ORR Change Memo No. 107).
3-7-73	Counting-rate meter and pre-amplifier	Replacement	The units were replaced to correct an erratic readout.
		No. 1 Log-N Channel	
1-12-73	Log-N amplifier	Modification	A current adder circuit was added to the Log-N amplifier in order to prevent possible false periods during reactor start-up (ORR Change Memo No. 106).
2-13-73	Log-N recorder chart drive motor	Replacement	The motor was replaced to furnish recorder chart rewind.

Table 6 (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
2-26-73	Log-N recorder	Replacement	The amplifier and balance motor were replaced to correct an erratic readout.
3-1-73	Log-N recorder zener power supply	Replacement	The power supply was replaced to correct an erratic readout.
3-8-73	Log-N amplifier	Tube replacement	The faulty voltage regulating tube, OA-3, was replaced to correct an erratic readout on the Log-N period recorder.
		No. 2 Log-N Channel	
1-12-73	Log-N amplifier	Modification	A current adder circuit was added to the Log-N amplifier in order to prevent possible false period indications during reactor start-up (ORR Change Memo No. 106).
2-20-73	Log-N recorder chart drive motor	Replacement	The motor was replaced to furnish recorder chart rewind.
3-15-73	Log-N amplifier	Replacement	The unit was replaced to correct an erratic readout on the Log-N recorder.
		No. 1 Safety Channel	
			No maintenance or changes were required.

Table 6 (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
		No. 2 Safety Channel	
1-16-73	No. 2 safety ion chamber	Routine saturation tests	When routine saturation checks were performed, the chamber did not meet instrumentation and controls standards.
1-22-73	No. 2 safety ion chamber	Routine saturation tests	A monitor was installed on the chamber for further tests.
1-24-73	No. 2 safety chamber	Replacement	The PCP chamber (PCP III-106-66-5) was removed because it would not meet instrumentation and controls specifications. Chamber CTC-2 (C-768) was installed
		No. 3 Safety Channel	
			No maintenance or changes were required.
		Magnet Amplifiers	
			No maintenance or changes were required.
		Nos. 1 and 2 Gamma Channels	
			No maintenance or changes were required.
		North N^{16} Channel	
			No maintenance or changes were required.

Table 6 (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
		South N^{16} Channel	
2-26-73	Recorder	Replacement (routine maintenance)	The replacement of the balance motor was initiated because the one in use did not meet specifications.
		Micromicroammeter Channel	
			No maintenance or changes were required.
		Servo Channel	
			No maintenance or changes were required.
		Reactor Noise Monitor	
1-4-73	Monitor	Out of calibration	The noise monitor was checked and calibrated.
		Radiation Detection Instrumentation	
2-27-73	Cell ventilation radiation module detector	Replacement	The replacement of the module was initiated because the one in use was found to be faulty when the building cell-ventilation checks were performed on February 26, 1973.
		Process Instrumentation	
1-23-73	No. 1 exit temperature recorder battery.	Replacement	The battery was replaced to correct an erratic readout.

Table 6 (Continued)

Date	Component	Trouble or Change	Reason or Maintenance
2-20-73	Outside temperature element	Replacement	The sensing element was replaced and the blower repaired.
		Facility Radiation and Contamination Alarm System (FRCAS)	
1-25-73	Continuous air monitors, hot cell and P-tube	Erratic readout	The tubes in the monitors were replaced to correct an erratic readout.
2-1-73	Entire system	Routine test	A functional check of the system was made by Instrumentation and Controls Division personnel. The results were satisfactory.
		Shim-Rod Control Circuitry	
1-12-73	Servo relays	Replacement	Routine maintenance inspection revealed relays 13X and 14X to be in need of replacement.
1-12-73	No. 2 shim-rod seat switch	Replacement	The shim-rod seat switch was replaced as the one in service failed to operate properly.

Table 7. Present Status of Ionization Chambers and Fission Chambers

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
			Installed Chambers		
PCP-III-106-66-9	Position 7	No. 1 safety	September, 1966 (safety)	None	No trouble; fabricated at ORNL. Compensated section used from February, 1969, until March, 1970, as No. 1 Log N.
PCP-III-106-66-5	Position 2	No. 2 log N	November, 1971	ORR	Used as No. 2 safety and No. 2 log N from September 27, 1968, to July 22, 1970, and from May 7, 1971, to May 20, 1971.
CTC-2 (C-768)	Position 3	No. 2 safety	January 24, 1973	LITR-BSR	Served as LITR safety chamber from February, 1962, to July, 1965. Modified for underwater service in 1969. Installed in the BSR in April, 1970, and in August the chamber was removed to storage.
PCP-II-106-63-3	Position 4	No. 3 safety and No. 1 log N	May, 1964(safety) March, 1970 (log N)	None	No trouble; fabricated by ORNL.
PCP-II-106-63-4	Position 5	Servo and micromicro-ammeter	June, 1964	None	No trouble; fabricated by ORNL.

Table 7 (Continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
TSM-2-F45	Poolside	No. 1 counting rate, north	April 26, 1971	None	Replaced fission chamber "snake" assembly S27-34R-F29.
CTC-5 (C-770)	Position 8	Noise monitor	October, 1971	LITR	Used as No. 1 safety at the LITR; modified for ORR-BSR underwater service.
PCP-II-105-63-2	Poolside, south	No. 1 gamma, south	April 26, 1972	ORR	Used as No. 2 gamma, north, from April, 1964, until December, 1970.
PCP-II-105-63-3	Poolside, north	No. 2 gamma, north	August 17, 1971	ORR	Used as No. 1 gamma, south, from April, 1964, until March, 1970.
TSM-3-F29	Poolside	No. 2 counting rate	October 24, 1972	None	Replaced fission chamber "snake" assembly TSM-1-F52.
		Spare Chambers			
PCP-II-105-63-1	ORR plug storage	Awaiting repair	April 26, 1972	ORR	Used as No. 1 gamma, south, from March 31, 1970, until April 26, 1972.
TSM-1-F52	ORR I&C shop	Awaiting repair	April 26, 1972	ORR	Used as No. 2 counting rate (south) from April 26, 1972, until October 24, 1972.

Table 7 (Continued)

Chamber Serial No.	Location	Present Service	Date Present Service Started	Previous Service	Remarks
S27-34R-F29	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 1 counting rate from July 28, 1970, to April 26, 1971.
S3-8R-F22	ORR plug storage	Awaiting repair	April 26, 1971	ORR	Used as No. 2 counting rate from January 14, 1970, to April 26, 1971.
CTC-1	ORR plug storage	Awaiting repair	October, 1971	ORR	Used as noise monitor from March, 1962, until October 1, 1971.
CTC-4 (C-769)	ORR plug storage			LITR	Used as No. 2 safety in the LITR; modified for ORR-BSR underwater service.

Table 8. Process Systems, Maintenance and Changes

Date	Component	Remarks
	Reactor Primary Cooling System	
1-9-73	Primary water lines	Inspection Engineering X-rayed welds on the primary pump lines at the pump house. The job was not completed; it will be continued on the next end-of-cycle shutdown.
1-9-73	Bypass filters	The filter cartridges were replaced.
1-9-73	Demineralizers	The strainers in all the demineralizers were checked and some gaskets were replaced.
1-11-73	South reactor demineralizer	The flow integrator which was faulty was replaced.
2-26-73	Primary water lines	The X-raying of welds on the water lines at the primary pump house continued.
2-27-73	Bypass filters	The filter cartridges were replaced.
	Reactor Secondary Cooling System	
1-10-73	Cooling tower and fans	The screens were cleaned and vibration checks were completed. The results were satisfactory.
1-30-73	Cooling tower fan controls	A faulty limit switch was replaced.
2-27-73	Pump motors	The resistance-to-ground was checked on each of the three motors. The results were satisfactory.

Table 8 (Continued)

Date	Component	Remarks
2-28-73	Cooling tower	Vibration checks were performed. The results were satisfactory.
	Pool Primary Cooling System	
1-9-73	Bypass filters	The cartridges were replaced.
	Pool Secondary Cooling System	
1-4-73	Acid-addition system	The new acid-addition pump, that was removed from service because of its malfunctioning on October 30, 1972, was returned from the factory and reinstalled. After proper adjustments were made, the system has operated satisfactorily.
2-27-73	Pump motor	The resistance-to-ground was checked, and the results were satisfactory.
	Emergency Cooling System	
1-8-73 and 2-26-73	Nos. 1, 2, and 3 dc units	Functional tests of equipment and alarms confirmed that the systems were in satisfactory condition.
	Pressurizable Off-Gas System	
3-28-73	Filter banks	The charcoal filters in the north bank were replaced.

Table 8 (Continued)

Date	Component	Remarks
	Electrical System	
1-9-73 and 2-26-73	Miscellaneous breaker panels for electric motors, dc batteries, battery racks, and control room instrument cabinets	Routine inspection and cleaning were performed. Relays 13X and 14X were replaced on January 9, 1973.
	Emergency Electrical System	
1-9-73 and 2-27-73	Diesel generator	The routine end-of-cycle load test was performed with satisfactory results. The diesel muffler was replaced on January 9, 1973.
	Miscellaneous	
1-9-73	Reactor tank	The gasket for the access cover was replaced.
2-26-73	Centravac unit	The cleaning and inspection of the electrical components were performed.
2-26-73	Control room heating and ventilation unit	The two faulty steam coils were replaced.
3-8-73	Basement steam condensate tank	A new level control switch was installed.
3-15-73	Radiography facility	Proper repairs were performed to stop an air leak on the collimator purge line.

Table 8 (Continued)

Date	Component	Remarks
	Experimental Facilities	
2-1-73	Beam hole No. 3	A short in the transformer for the demagnetic side caused a fuse to blow. Proper repairs were performed.
2-27-73	Beam hole Nos. 1, 2, 3, 4, 5, 6, and HN-1 and HN-4	The pressure relief valves were replaced on the facilities. The replacement was part of the routine preventive maintenance program of reactor operation.

Table 9. Reactor Mechanical Components, Maintenance and Changes

Date	Component	Remarks
1-9-73	Access cover	The gasket on the access cover was replaced.
1-9-73	Lucite windows	The Lucite windows were inspected and found to be in satisfactory condition.
2-26-73	No. 3 shim-rod operator assembly	The No. 3 shim-rod operator assembly mark G-7 was replaced with a spare operator assembly mark B-2. The change was made for routine inspection and maintenance of the mark G-7 assembly as follows: "O" ring on snubber oil plug was replaced; shock absorber pad was replaced; "O" ring (E-48242-7) at the snubber cylinder head was replaced; replaced oil in the snubber unit; and the piston and bearing in the snubber unit were inspected with satisfactory results.

Table 10. Status of Filters - Gaseous Waste Systems

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
		Cell-Ventilation System			
CWS	Overall*	North, June, 1964; South, 1-12-65	3-28-73	DOP	99.998
Charcoal	Both banks	North, 8-23-67; South, 10-17-67	2-5-73	Elemental iodine	99.88**
Rerun Charcoal	Both banks	North, 8-23-67; South, 10-17-67	2-9-73	Elemental iodine	99.982
Charcoal	Both banks	North, 8-23-67; South, 10-17-67	2-16-73	Methyl iodide	24.800
		Pressurizable Off-Gas			
CWS	North	4-3-68	3-28-73	DOP	99.996
Charcoal	North	2-26-73	2-26-73	Elemental iodine	99.990
CWS	South	10-18-67	3-28-73	DOP	99.998
Charcoal	South	12-8-69	2-27-73	Elemental iodine	99.996
		Basement Hood Exhaust			
CWS	South	2-16-72	3-20-73	DOP	99.997
CWS	North	2-16-72	3-20-73	DOP	99.997

*The CWS filters in the cell-ventilation system were checked in series.

**Low reading apparently was due to impure source.

Table 10 (Continued)

Type Filter	Bank Designation	Date Installed	Date Last Tested	Type Test	Retention Efficiency (%)
			Normal Off-Gas		
CWS	West	7-24-72	3-28-73	DOP	99.998
Charcoal	West	11-17-72	11-30-72	Elemental iodine	99.985
CWS	East	7-24-72	3-28-73	DOP	99.998
Charcoal	East	10-6-71	2-21-73	Elemental iodine	99.970
Charcoal	West	11-17-72	1-3-73	Methyl iodide	85.55

Table 11. Facilities Assignments (End of Quarter)

Facility	Access Flange	Nature of Experiment	Division or Other Sponsor
		Lattice Positions	
A-1	V-11		Available for assignment
A-2	V-11		Available for assignment
A-9	V-2	Equipped with a facility tube	Available for assignment
B-2	V-10	Equipped with a facility tube	Available for assignment
B-8	V-1		Available for assignment
B-9	V-2	Equipped with a facility tube	Available for assignment
C-1	V-9	Equipped with a facility tube	Reactor
E-2	None	Radioisotope (iodine and xenon) production	Isotopes
D-8	V-3	Hydraulic tube No. 2	Isotopes and Chemistry
F-1	V-8		Available for assignment
F-2	V-6	Equipped with a facility tube	Available for assignment
F-8	V-4		Available for assignment
F-9	V-5	Equipped with a facility tube	Available for assignment

Table 11 (Continued)

Facility	Access Flange	Nature of Experiment	Division or Other Sponsor
		Poolside Positions	
P-2, P-3, P-4, and P-8	None		Available for assignment
P-7	None	GCR capsule irradiations	Reactor
P-1 and P-9	None		Available for assignment
P-5	None		Available for assignment
P-6	None		Available for assignment
P-9*	None	Neutron radiography	Operations and Metals and Ceramics
P-9+*	None	Pneumatic tube for activation analysis	Chemistry
		Large Facilities	
HN-1	None	Beam-hole or loop experiments	Available for assignment
HN-2	None		Available for assignment

*The installation of these facilities does not prevent the use of P-9 position for capsule irradiation.

Table 11 (Continued)

Facility	Access Flange	Nature of Experiment	Division or Other Sponsor
HN-3	None	Pneumatic tube for activation analysis	Analytical Chemistry
HN-4	None	Equipped with a collimator	Available for assignment
HS	None	Equipped with gas-cooled loop 2 components (on standby)	Available for assignment
		Beam Holes	
HB-1	None	Available for beam-type experiment	Unassigned
HB-2	None	Neutron diffractometer	Solid State
HB-3	None	Neutron diffractometer	Solid State
HB-4	None	Neutron diffractometer	Chemistry
HB-5	None	Available for beam-type experiment	Unassigned
HB-6	None	Available for beam-type experiment	Unassigned

Table 12. Experiment Facility Usage

Facility	Date Installed	Date Removed	Description of Experiment	Division or Other Sponsor
D-8	3-10-67		Hydraulic tube No. 2 used for isotope production and short-term irradiations	Operations
F-2	7-26-71		Five aluminum rods, one Fe flux monitor in aluminum can, 1-mg rod and aluminum can	Metals and Ceramics
GCR P7-A	8-8-72		GB-10 capsule experiment	Reactor
P-9	12-10-69		Neutron radiography	Operations and Metals and Ceramics
P-9+	10-18-67		Pneumatic tube for irradiation of short-lived isotopes	Chemistry
HB-2	7-58		Neutron diffraction experiments	Solid State Physics
HB-3	11-1-59		Neutron diffraction experiments	Solid State Physics
HB-4	7-58		Neutron diffraction experiments	Chemistry
HN-3	11-59		Activation analysis	Analytical Chemistry
HN-4	12-15-63		Void determinations in irradiated materials	Solid State Physics
HN-4	12-15-63		"Fly's Eye" two-dimensional neutron detector for neutron diffraction and radiography	Instrumentation and Controls

Table 13. Additions and/or Revisions to the ORR Operating Manual (ORNL-TM-506)

Date	Section	Title	Remarks
		Addition	
1-5-73	12	Information and Job Instruction Check Lists	The Information and Job Instruction Check List for the Oak Ridge Research Reactor (Example 12.1), Operation Check List for Building 3004 (Example 12.2), and Instruction Check List for LITR Standby - Building 3001 (Example 12.3) are used as guides for training reactor operating personnel, principally to insure that all areas of the complex are covered. The check lists are also useful for periodic review of the facilities. The principal sources of information to be used with the check lists are the "ORR Operating Manual", "The Oak Ridge Research Reactor - A Functional Description", "Drawing File", "Operating Safety Limits for the Oak Ridge National Laboratory Research Reactor (ORR)","Operating Manual for the LITR", "Operating Manual for the Shutdown OGR", and "Special Instruction Notebook".

APPENDIX A

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

January 12, 1973

TO: Distribution

SUBJECT: Calibration of ORR Shim Rods

The ORR shim rods were calibrated on January 11, 1973, at the beginning of cycle 110. The reactor was fueled with loading 110A containing 4839 grams of ^{235}U.

A summary of the results of the measurements are given along with the results from previous measurements in Table 1 below. Integral and differential worth curves are attached.

This calibration was made necessary because of a change in the schedule for shim-rod utilization, i.e., the new shim rod (one per cycle) is now to be placed in core position D-6, rather than F6, and will be moved in succeeding cycles to positions F4, B6, B4, F6, and F4 in the order given. The arrangement of shim rods for the work reported here simulated the arrangement described above, as the oldest (most burnup) rod was placed in core position F4, and the new rod in D6, with others following the prescribed order according to usage.

The total worth of the shim rods decreased somewhat from that reported for the previous calibration; however, the worth of rods 3-6 was increased appreciably, especially in the upper half of travel. Specifically, the worth above 12 inches withdrawn was increased from $\sim$8% $\Delta K/K$ to slightly more than 10% $\Delta K/K$. This is a decided improvement, as fuel utilization should be helped, and fuel cycles can be extended.

Minimum shim rod positions at critical for all operation, as a result of these calibrations, will be:

a. Rods 1 through 6 ganged at 12.4 in. withdrawn or

b. rods 3-6 ganged at 11.6 in. withdrawn with rods 1 and 2 at upper limits.

The beginning of cycle upper limit positions for shim rods 4 and 6 were established as 28.4 inches and 27.25 inches respectively, as withdrawal above these positions resulted in a small negative reactivity addition (In the case of No. 4 rod, the negative reactivity worth above 28.4 was very low and was not measured; the negative worth of No. 6 above 27.25 inches was less than 0.1% $\Delta K/K$).

The upper limit positions may be changed during operation if approved by supervision, as the worth above the limits becomes positive as the flux pattern in the reactor is changed by withdrawal of the shim rods.

Table 1. Results of Shim Rod Calibration (% ΔK/K)

Shim Rod No.	8-18-71 Cycle 101A 5037 g*	2-2-72 Cycle 104A 4999 g*	4-7-72 Cycle 105A 5190 g*	1-11-73 Cycle 110A 4839 g*
1	3.211	------	3.548	1.751
2	2.473	------	2.634	1.335
3	3.267	2.904	3.065	3.162
4	5.006	------	5.198	4.770
5	3.642	2.718	3.286	3.764
6	5.827	------	5.444	6.258
1-2	5.684	------	6.182	3.086
3-6	17.742	------	16.922	17.954
1-6	23.426	------	23.174	21.040

*30 fuel positions, including shim rods.

S. S. Hurt, III

T. P. Hamrick

SSH:TPH:sw

cc: ORR File
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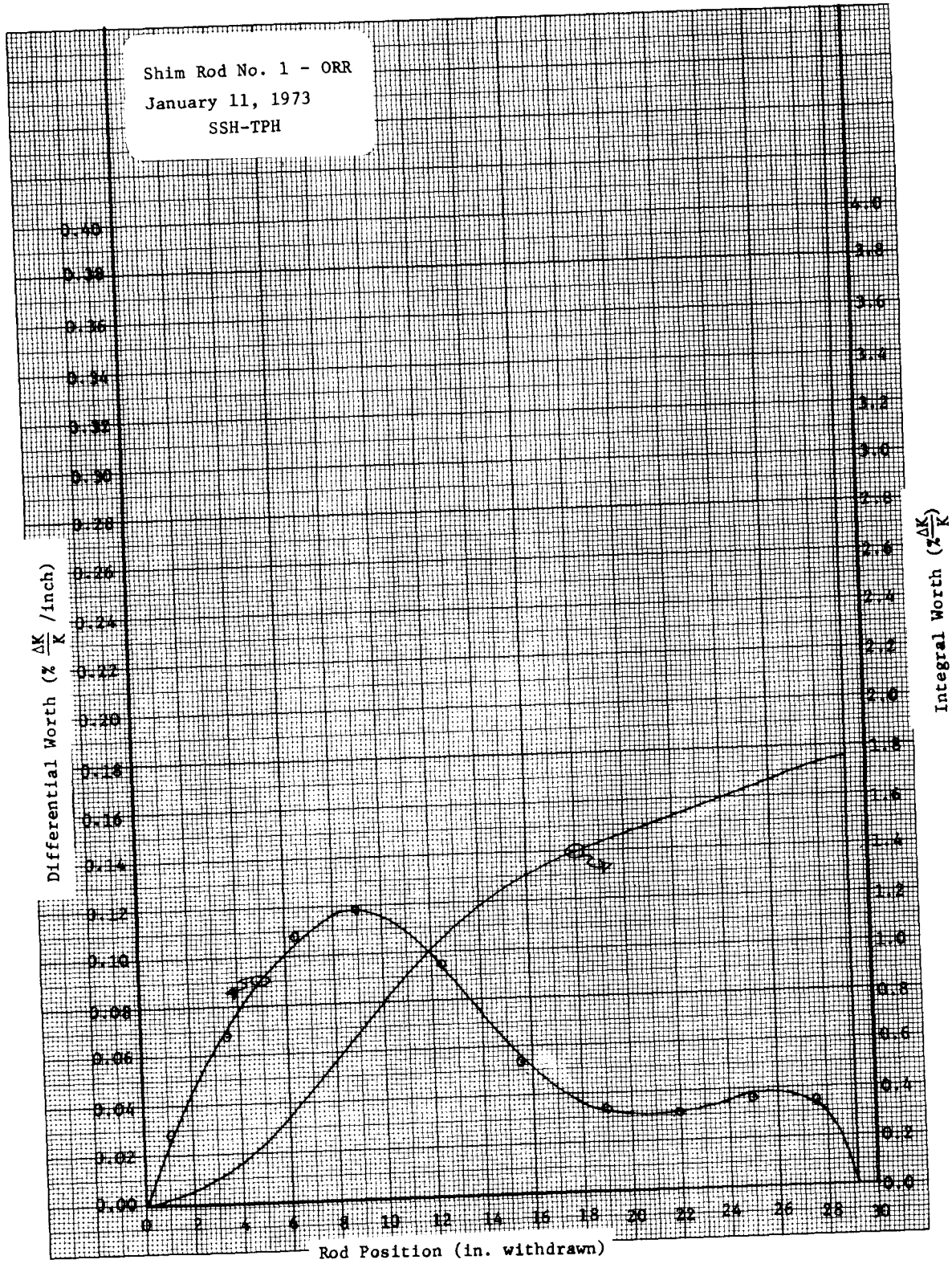
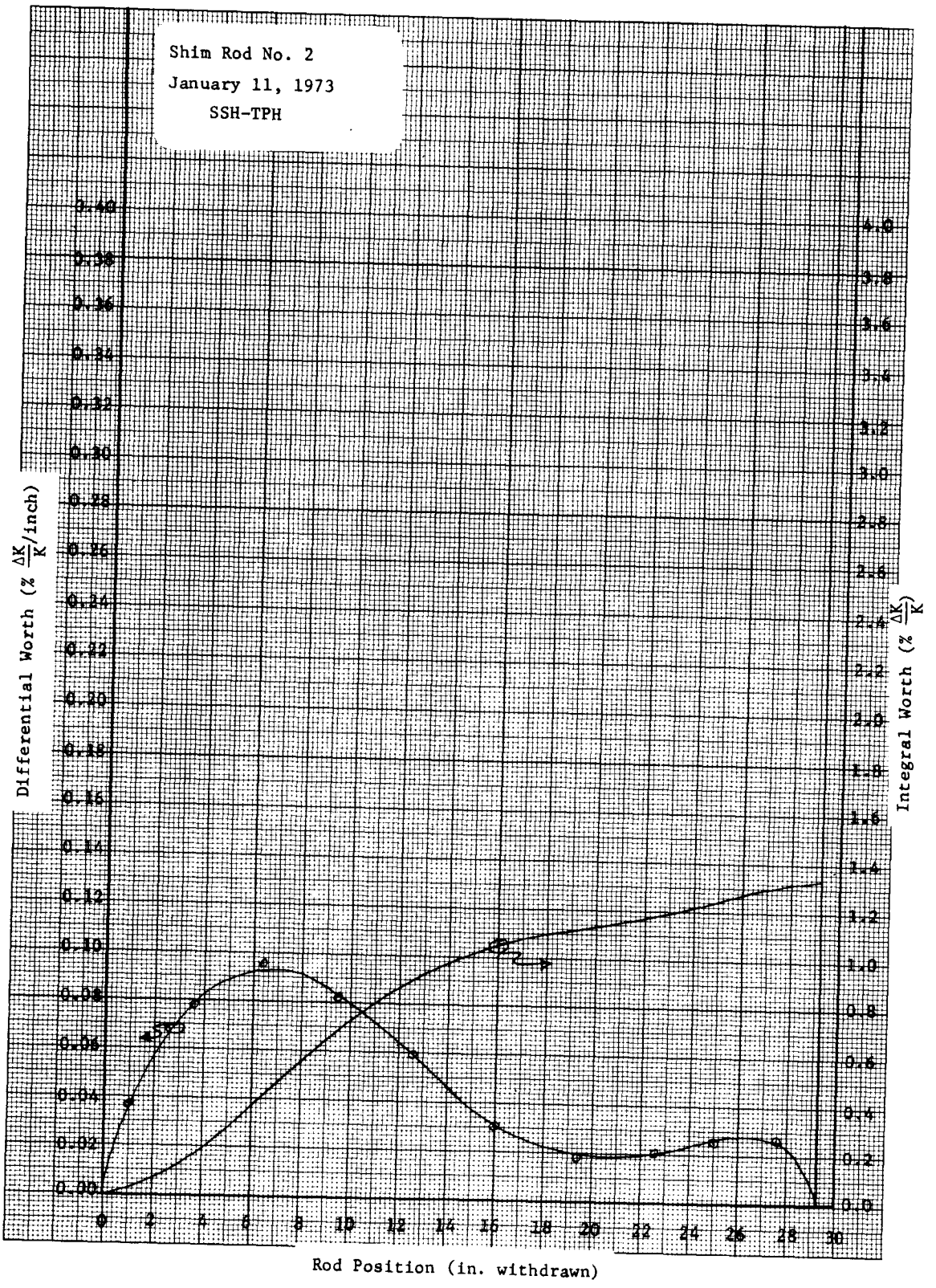
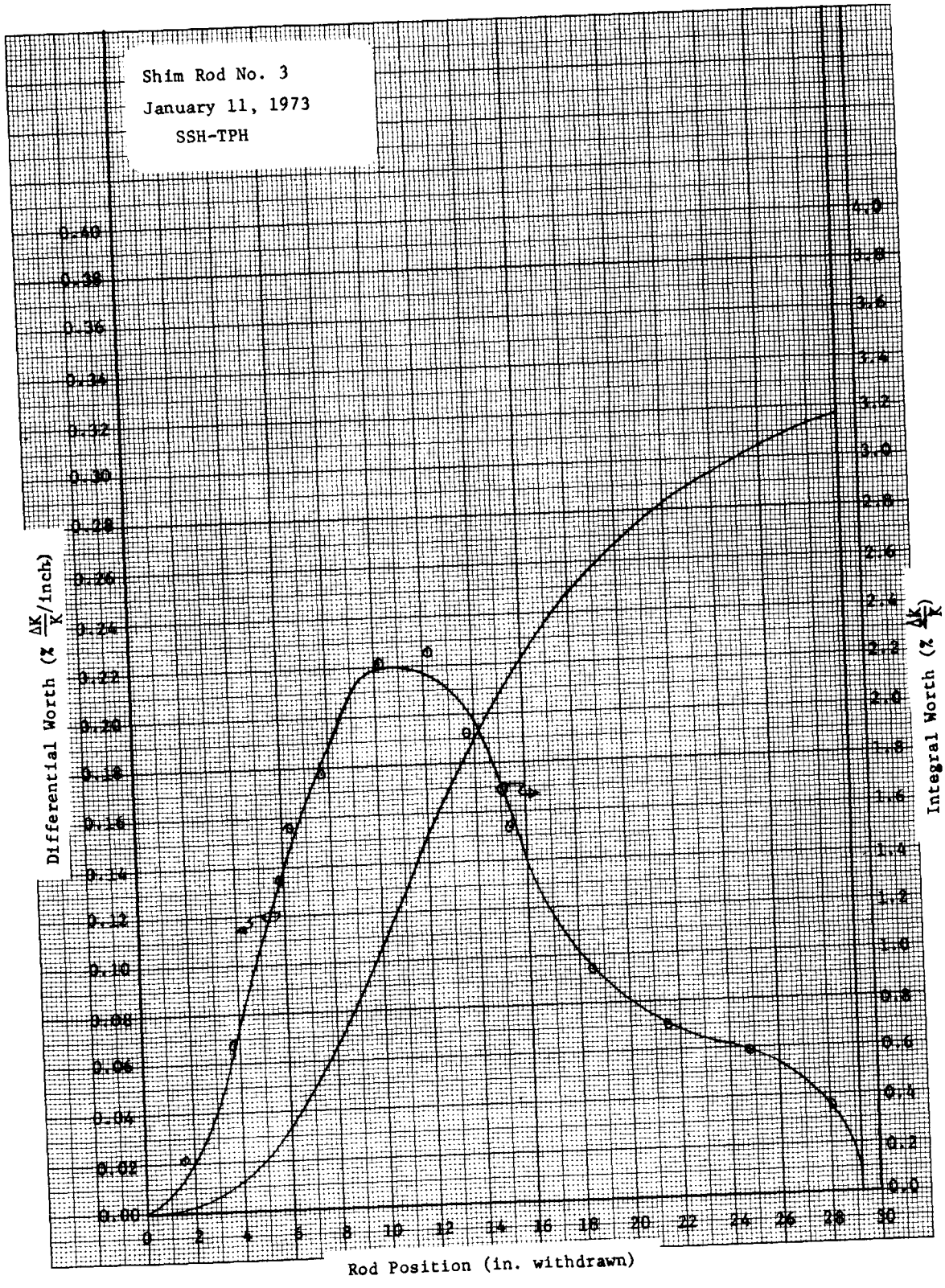
J. A. Cox
C. B. Gaither
T. P. Hamrick File
E. D. Lance
W. H. Tabor
SSH File (2)


Shim Rod No. 1 - ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K /inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.40
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Shim Rod No. 2
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30


Shim Rod No. 3
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.40
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
0
2
4
6
8
10
12
14
16
18
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22
24
26
28
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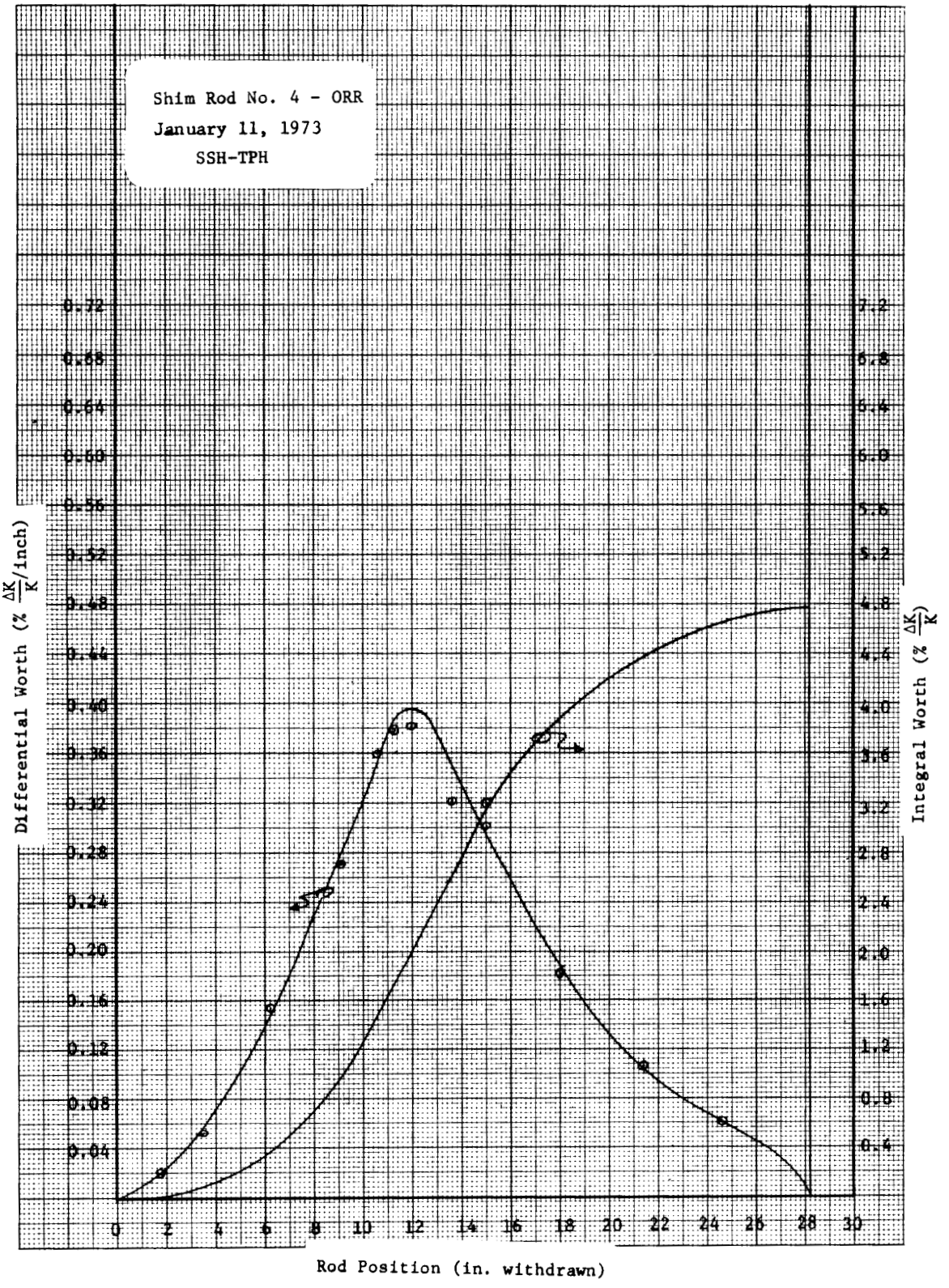
Shim Rod No. 4 - ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.72
0.68
0.64
0.60
0.56
0.52
0.48
0.44
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
7.2
6.8
6.4
6.0
5.6
5.2
4.8
4.4
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0
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28
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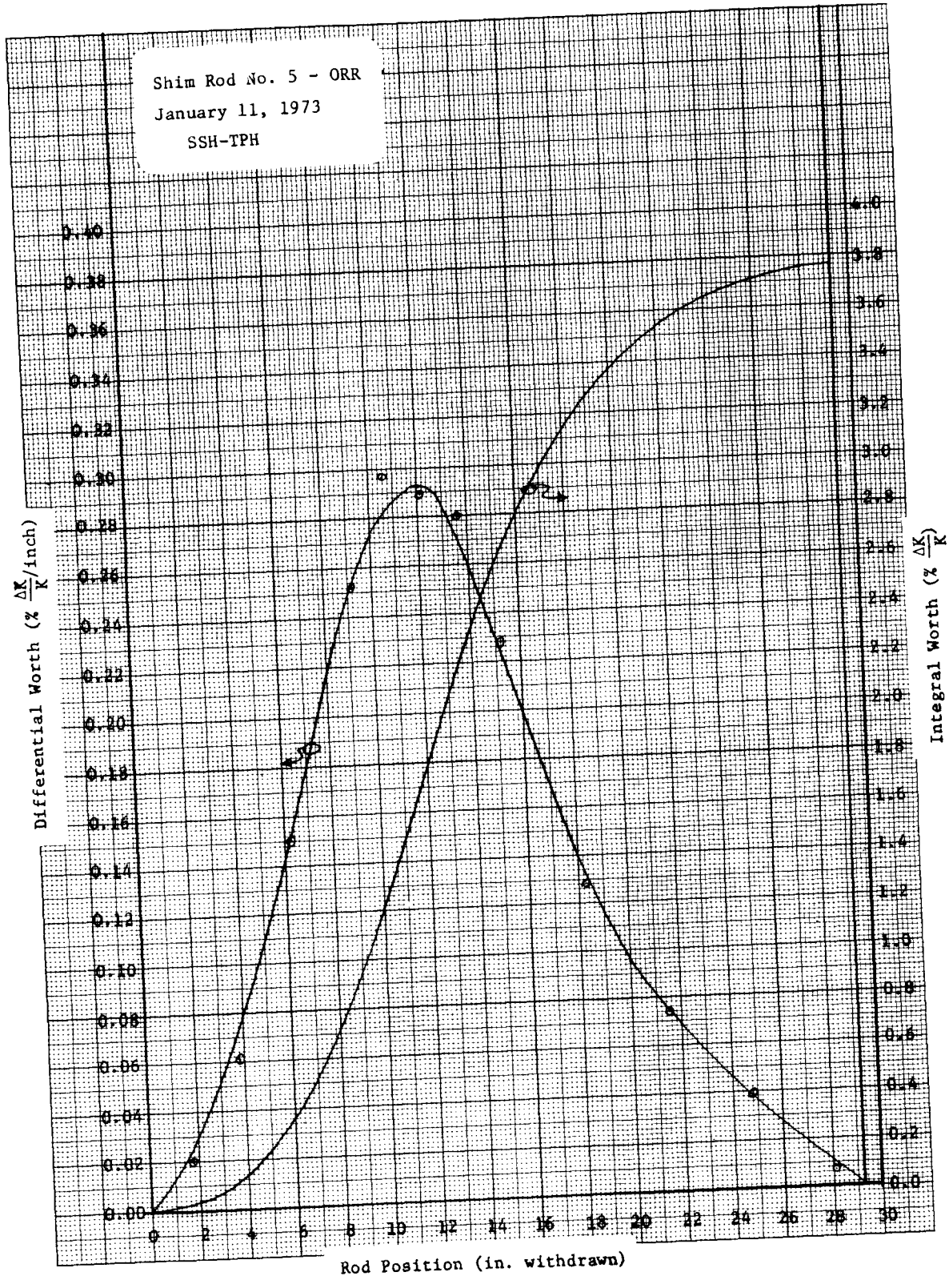
Shim Rod No. 5 - ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.40
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
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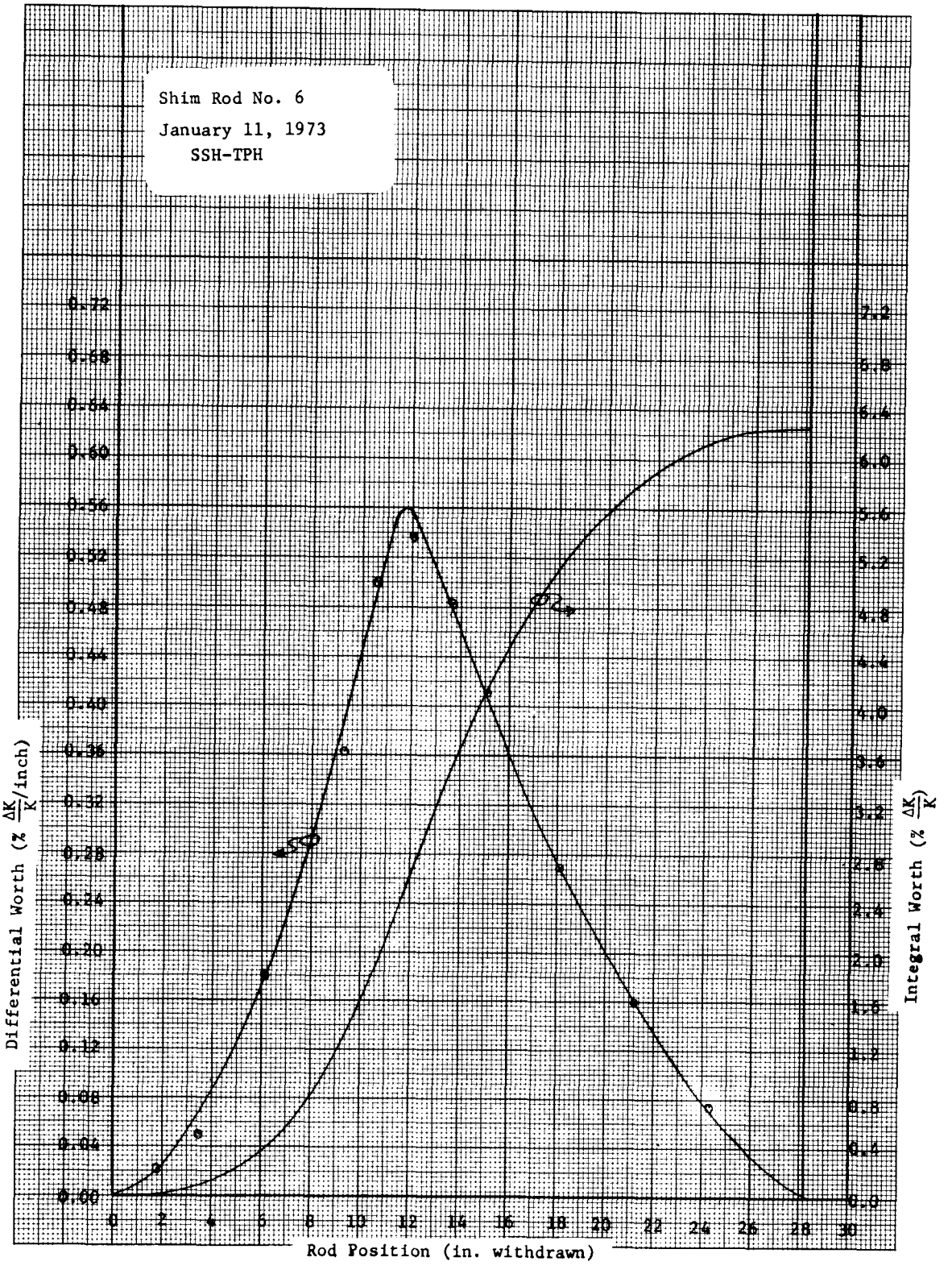
Shim Rod No. 6
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.72
0.68
0.64
0.60
0.56
0.52
0.48
0.44
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
7.2
6.8
6.4
6.0
5.6
5.2
4.8
4.4
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
0
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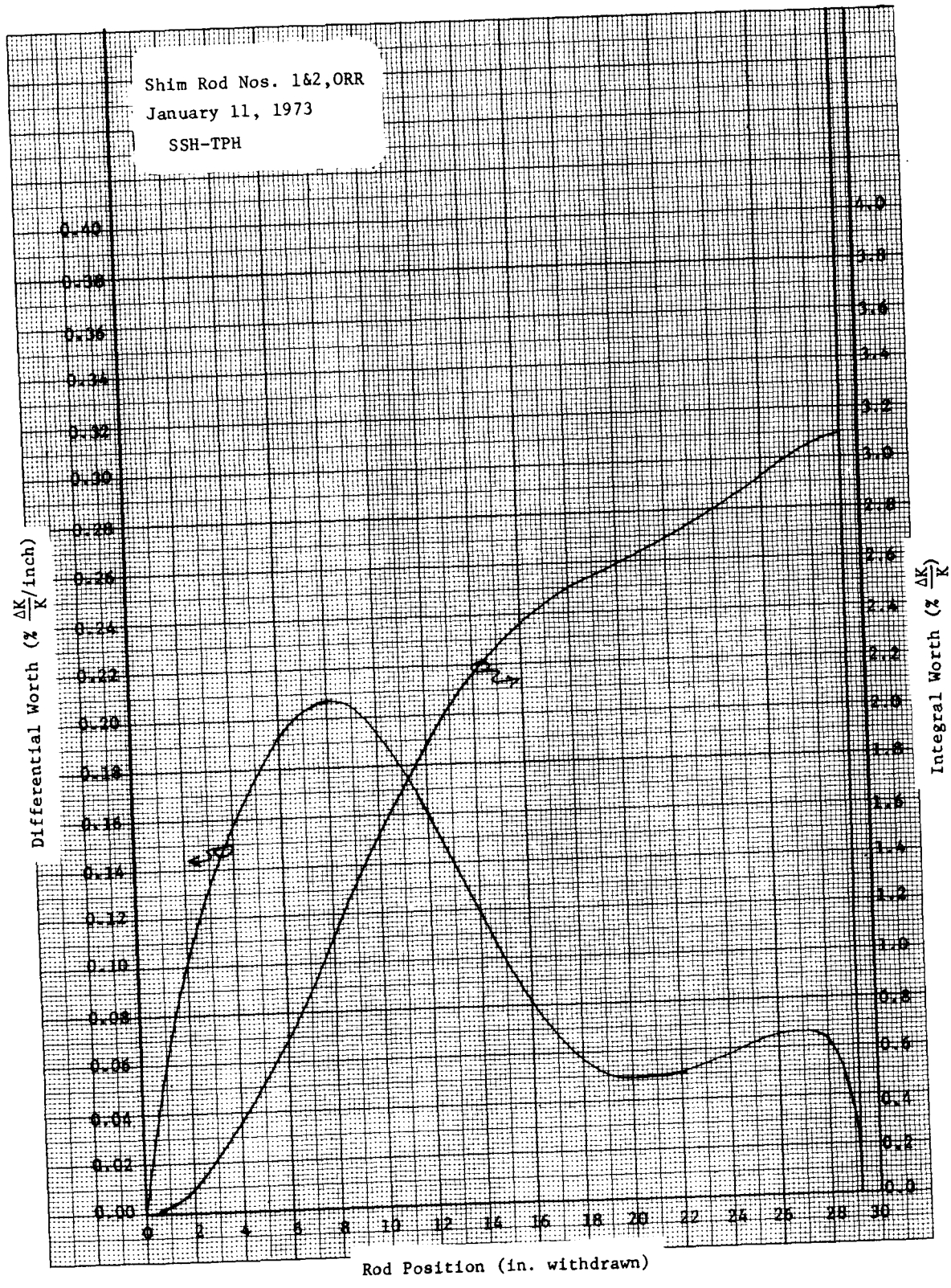
24
26
28
30


Shim Rod Nos. 1&2,ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.40
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
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2
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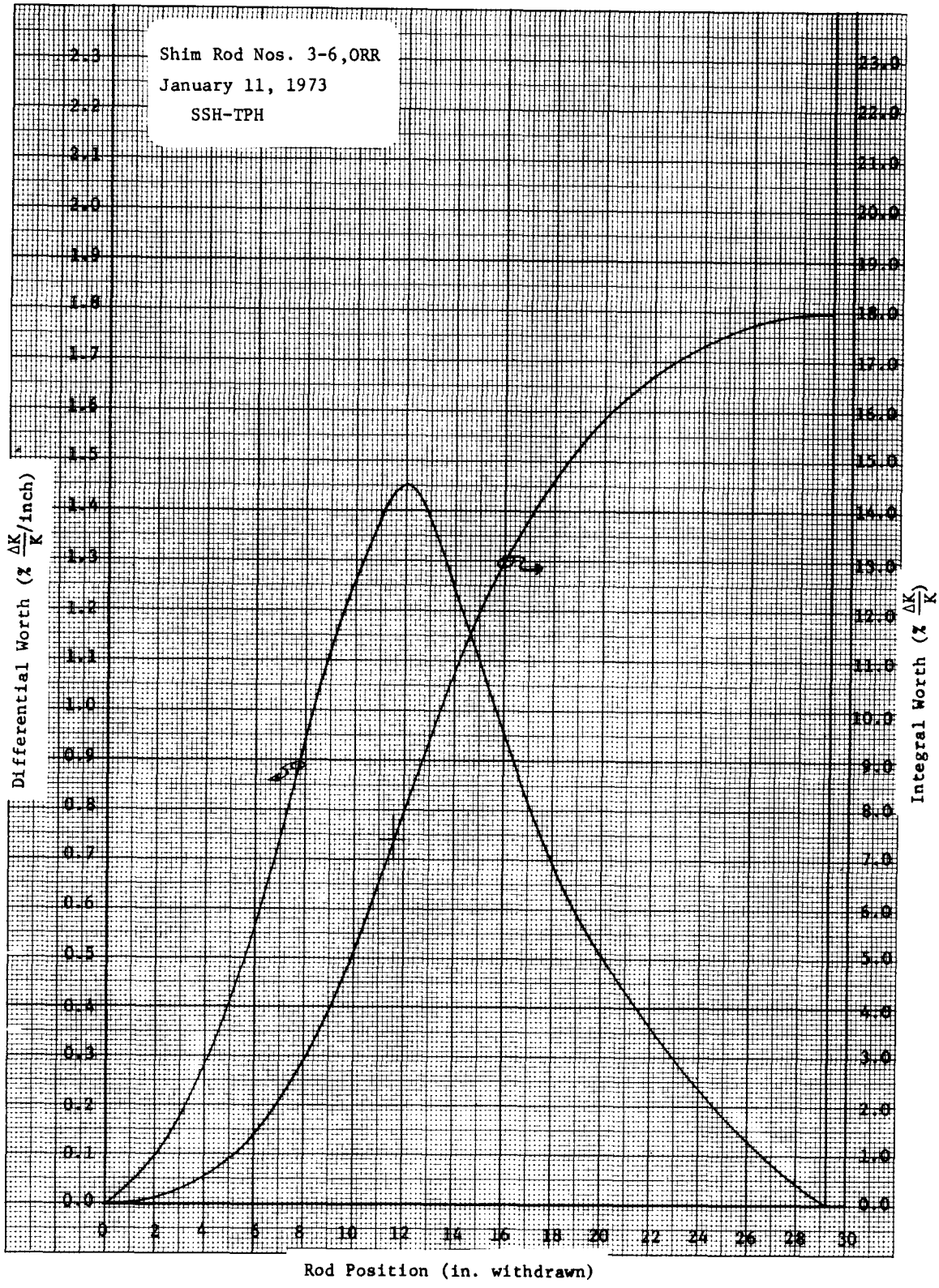
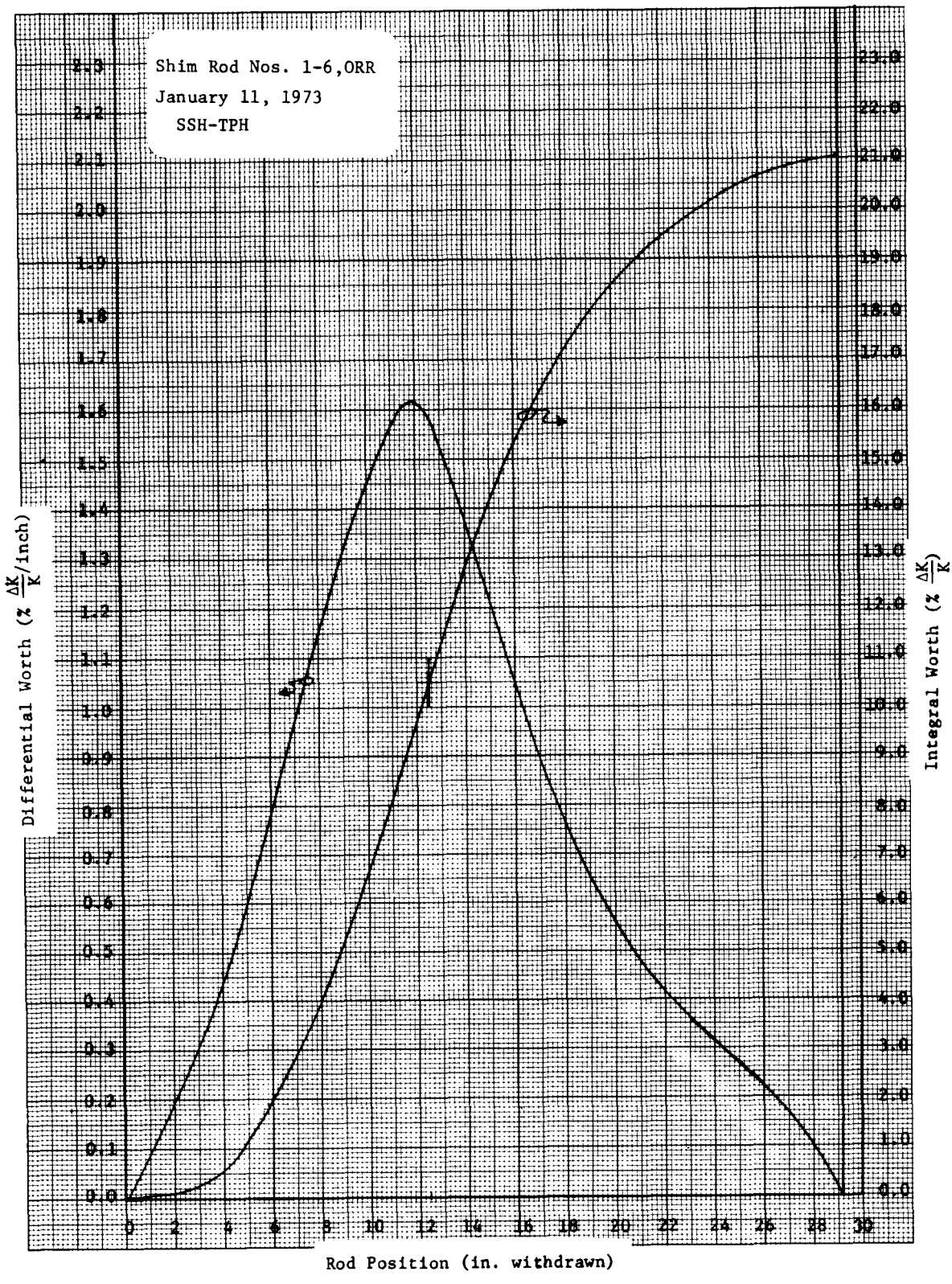

Shim Rod Nos. 3-6,ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0


Shim Rod Nos. 1-6,ORR
January 11, 1973
SSH-TPH
Differential Worth (% ΔK/K/inch)
Integral Worth (% ΔK/K)
Rod Position (in. withdrawn)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2.0
2.1
2.2
2.3
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
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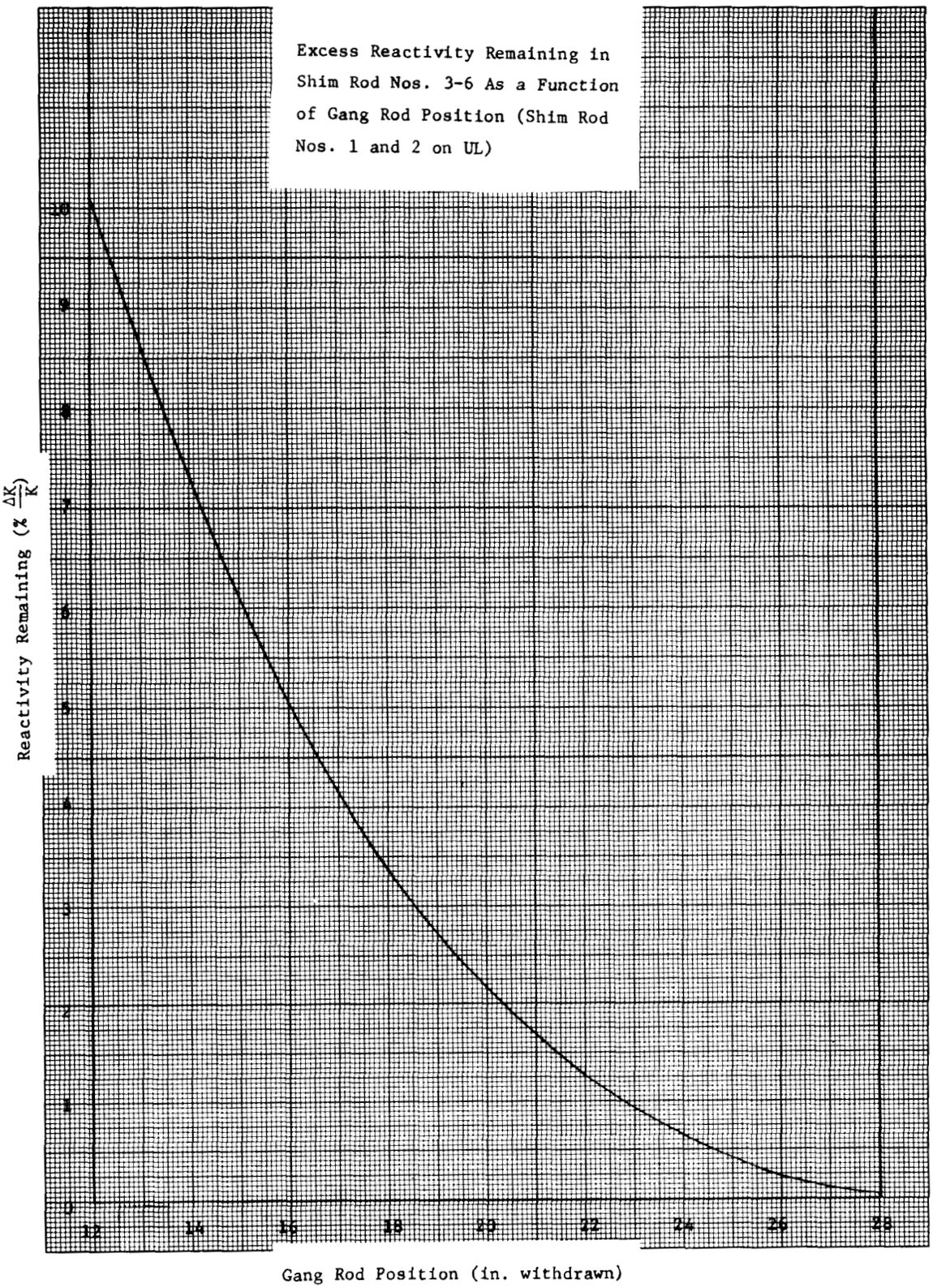
Excess Reactivity Remaining in Shim Rod Nos. 3-6 As a Function of Gang Rod Position (Shim Rod Nos. 1 and 2 on UL)
Reactivity Remaining (% ΔK/K)
10
9
8
7
6
5
4
3
2
1
0
12
14
16
18
20
22
24
26
28
Gang Rod Position (in. withdrawn)

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