

Transient Rod Drop Time

A Synopsis of a Reportable Event

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Brief Description

- Transient rod is a pneumatically coupled control rod. Used primarily for steady-state operations and reactor pulsing.

Transient Rod

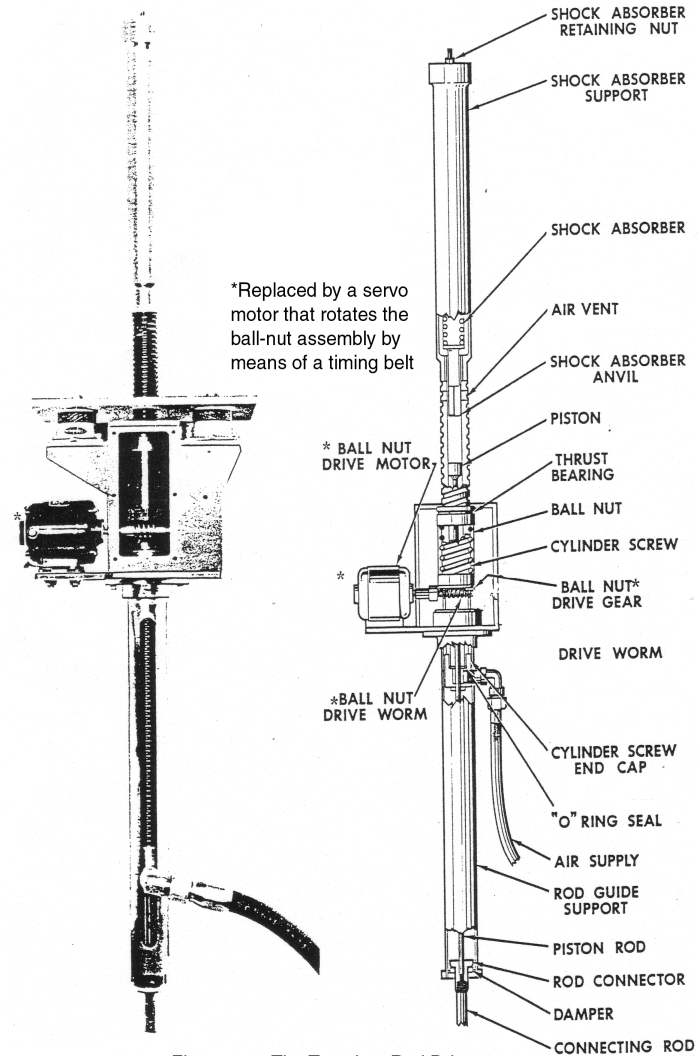
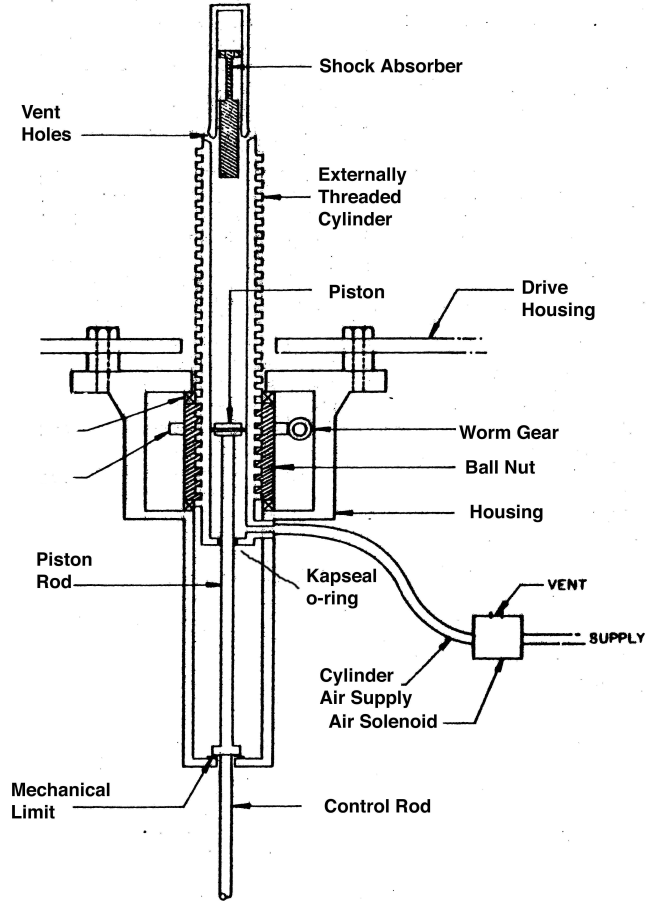


Figure 4.17 The Transient Rod Drive

Simplified Drawing



What happened?

- During a Nuclear Engineering laboratory, Reactor Operations and Testing, the Tr rod appeared to be slow falling into the core after a pulse trip as observed on DCC-X by the operator.

DCC-X Control Computer



Tech. Spec. Requirement

- The time from SCRAM initiation to the full insertion of any control rod from a full up position shall be less than 1 second.

Immediate Actions

- Reactor Immediately Secured
- Duty SRO Notified
- Associate Dir. of Operations Notified
- System Expert Notified
- AP-4 Event Evaluation Initiated

The Investigation

- Message log reviewed.

Message Log

14:39:30	rrs 29985	T Puke in Progress	DO
14:39:30	fac 5060	T N-16 Pumprequested on	DO
14:39:32	ssf 9220	T Puke Timer SCRAMed	(RSS) DI
14:39:32	rrs 4060	T Reg Rod SCRAMed	(RSS) DI
14:39:32	rrs 4070	T Shim Rod SCRAMed	(RSS) DI
14:39:32	rrs 4080	T Safety Rod SCRAMed	(RSS) DI
14:39:32	rrs 4090	T Transient Rod SCRAMed	(RSS) DI
14:39:32	rrs 7160	T Manual Mode entered	
14:39:32	rrs 11100	F Apply Air to Transient Rod	DO
14:39:32	rrs 29985	F Puke in Progress	DO
14:39:33	ssf 6060	T FC Power High X-SCRAM	
14:39:33	ssf 6065	T GIC Power High X-SCRAM	
14:39:33	ssf 8080	T X-SCRAM Requested	DO
14:39:33	rrs 8060	T Reg Rod Bottomed	DI
14:39:33	rrs 8160	T Shim Rod Bottomed	DI
14:39:33	rrs 8260	T Safety Rod Bottomed	DI
14:39:35	fac 5060	F N-16 Pumprequested on	DO
14:39:36	ssf 6140	T Puke Timer tripped X-SCRAM	DI
14:39:36	rrs 8360	T Transient Rod Bottomed	DI

Message Log Indications

- Tr rod drop times appear to be correct on first pulse of the day (Pulse 7388 Typically 1-2 seconds)
- Pulse 7389 2 seconds.
- Pulse 7390 3 seconds.
- Pulse 7391 Tr rod drop time messages indicate 4 seconds.

Investigation Continues

- AP-10 DNO Placed on the Console
- Tr rod drop time measured (1.47 secs.) prior to any maintenance performance.
- Reportable Event due to drop time.
- CCP-9 (Checks and Calibration Procedure)
Tr Rod Cleaning and Lubrication
Completed
- Subsequent drop time was 0.760 ms.

Follow-up

- Tr rod drop measured 790 ms. 1 week later.
- Since multiple pulses are to be performed, A CCP-9 Tr rod lubrication is performed.
- As left Tr rod drop time 860 ms.
- Tr rod completely disassembled and inspected.

Cylinder End Cap with Damaged Kapseal



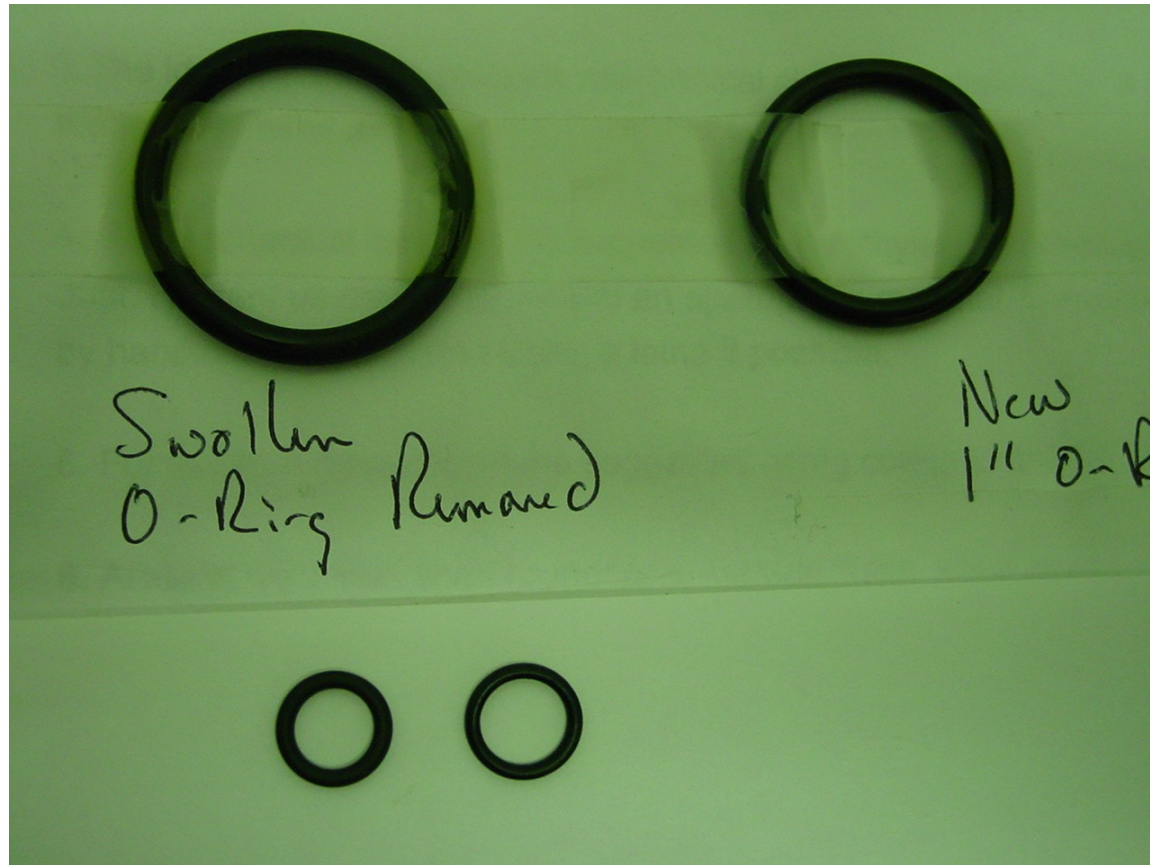
O-ring and Damaged Kapseal



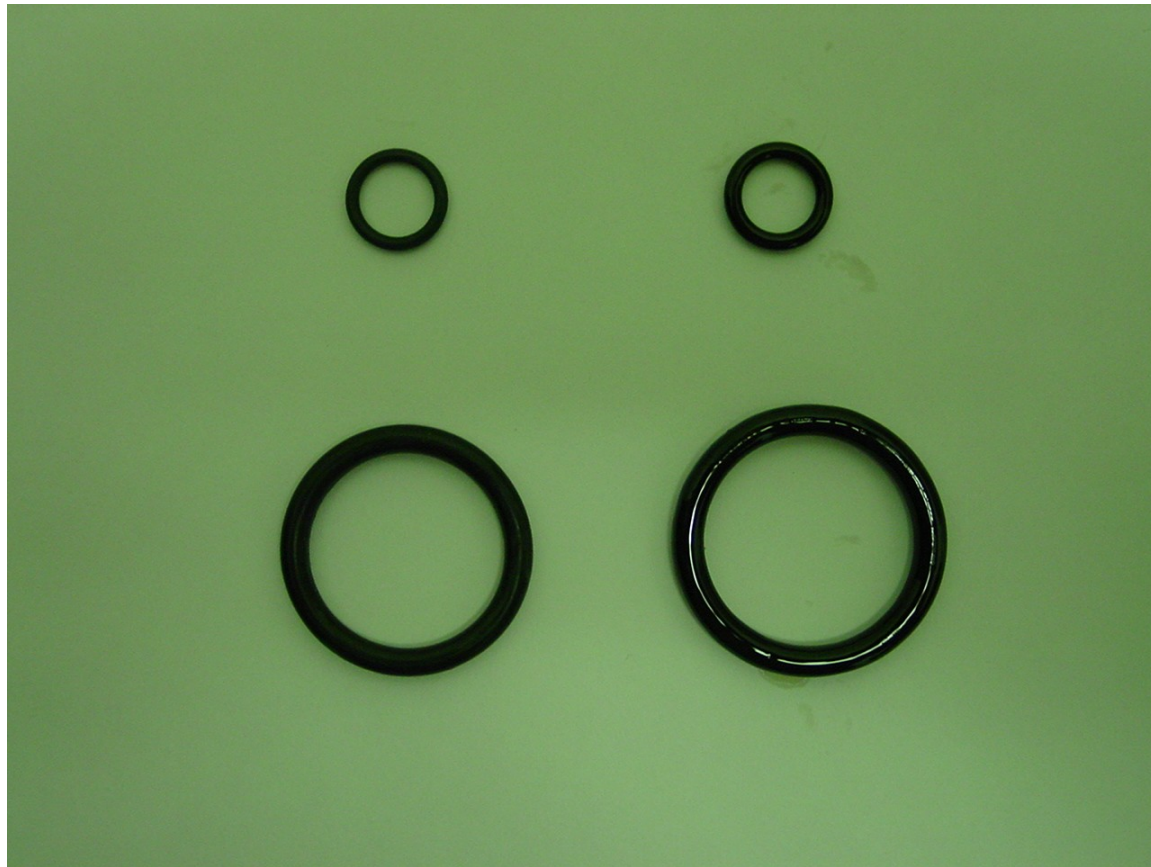
Damaged Kapseal



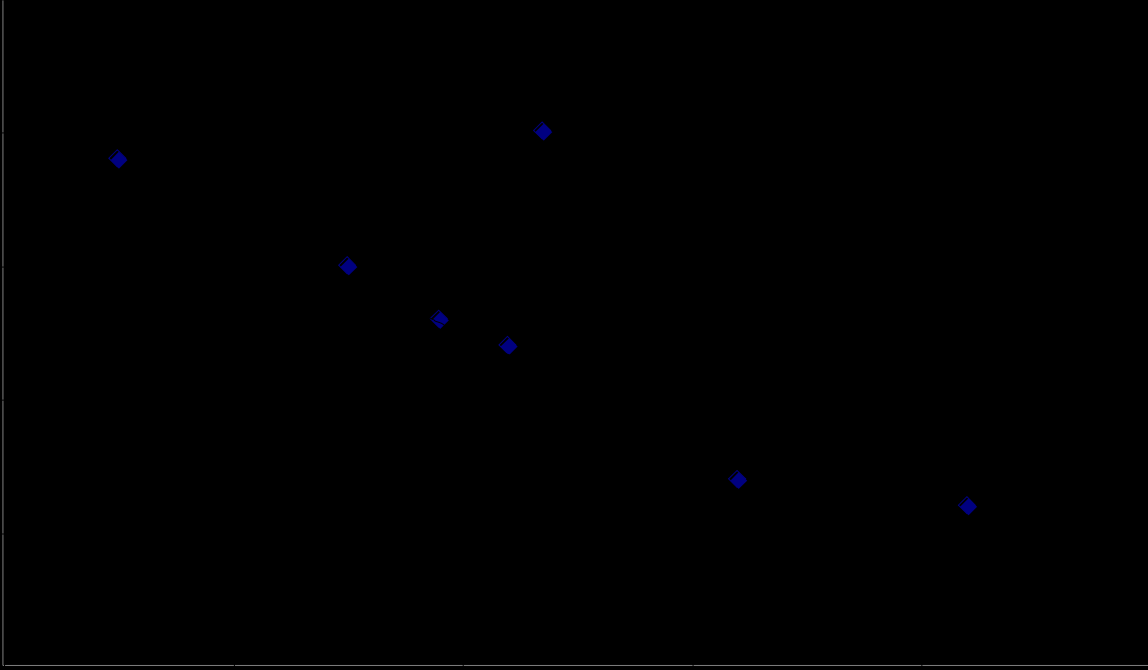
Swollen O-rings Removed



O-rings Subjected to Lubricant



Drag (oz)



Root Cause

- The damaged teflon Kapseal allowed the o-ring to contact the piston rod drastically increasing the friction.
- The seal was damaged by increased pressure exerted against the rod by the swollen o-ring.

Now What?

- Initially we implemented daily rod drop measurements, which, based on the data has been increased to weekly and now monthly.
- The CCP-9 Transient Rod Inspection has been modified to inspect and /or replace the Kapseal and o-ring annually.
- Lubricant is specifically identified.