HIGH PRESSURE SEALING SYSTEMS FOR BOILER CIRCULATING PUMPS

Alton Smith
Sr. Regional Sales Mgr
EagleBurgmann
Houston, TX, US

Eric Vanhie
Technical Specialist
EagleBurgmann
Houston, TX, US

27th International Pump Users Symposium

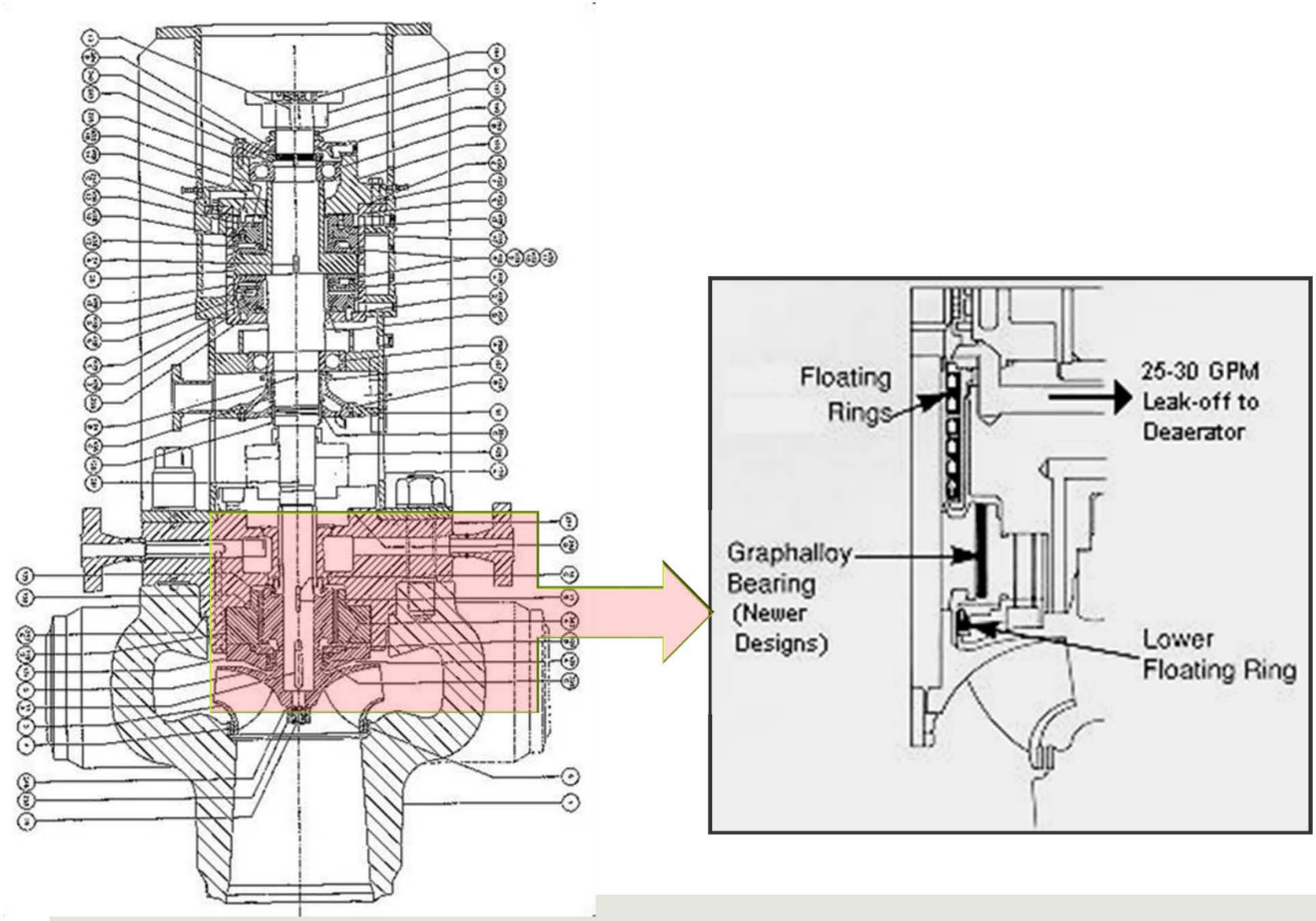
ABSTRACT

•Boiler circulating pumps are among the most critical and difficult rotating equipment in power plants. The bearings and seals are subject to very high loads with respect to forces and temperatures. Typical operating pressures range between 2,000 and 3000 psi, feed water temperatures between 600-700˚F.

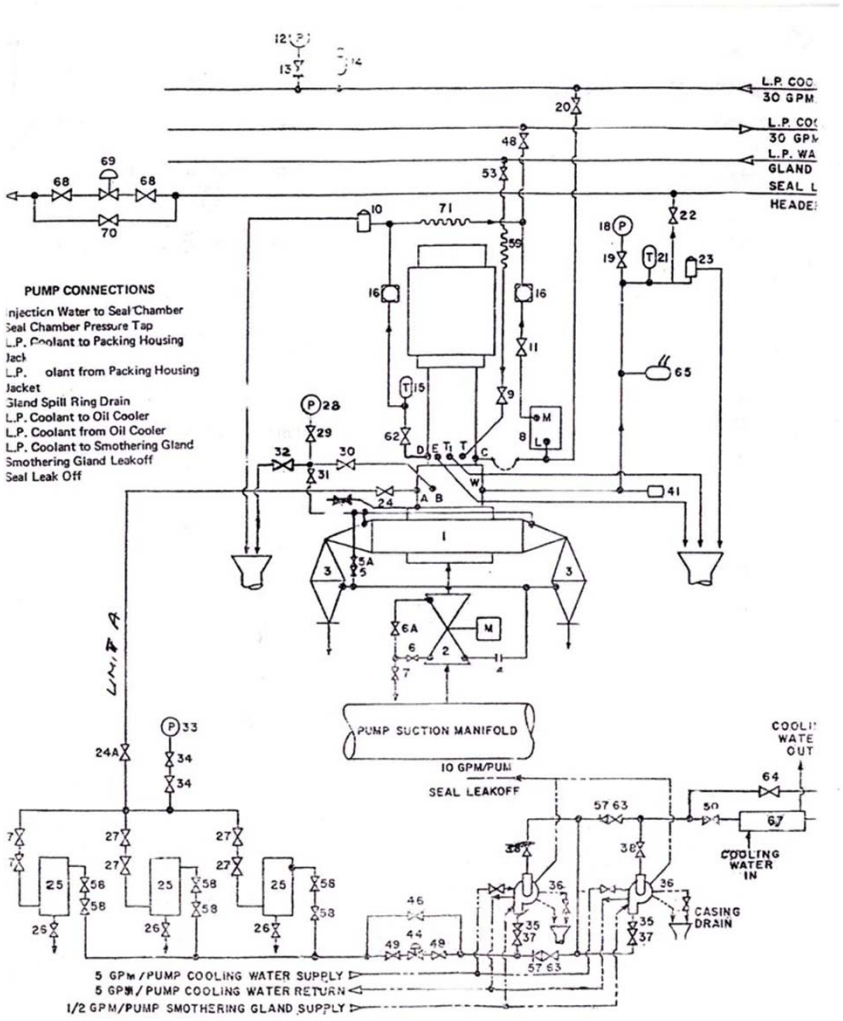
•In 1999 a power plant in Texas made the decision to forgo the typical sealing method (a series of floating rings in combination with a high-pressure water injection system) and seek a complete mechanical sealing system solution.

•Today, about 60 pumps are in operation with the new mechanical sealing solution with very good reliability results

Pump design & bushing seal with injection of cold condensate



INTRODUCTION



- Require an elaborate injection system for lubrication and cooling of the bushings
- Energy is wasted in the leak off flows which can be as high as 50 to 100 GPM for worn out bushings
- Ramp-up and shutdown times are much shorter for a pump with mechanical seals with plan 23
- The injection system contains a booster pump and a variety of control valves that require maintenance and energy
- The risk for oil contamination is higher as compared to mechanical seals
- Bushing seals are expensive and a refurbishment is almost as expensive as buying new seals and system.

NEW SEALING SYSTEM CONSIDERATIONS:

1. Due to the high load factor of this application, the sealed pressure must be staged to assure acceptable seal life regarding wear of the carbon face. Differential pressure method must be executed with investment cost, reliability and energy efficiency in mind.

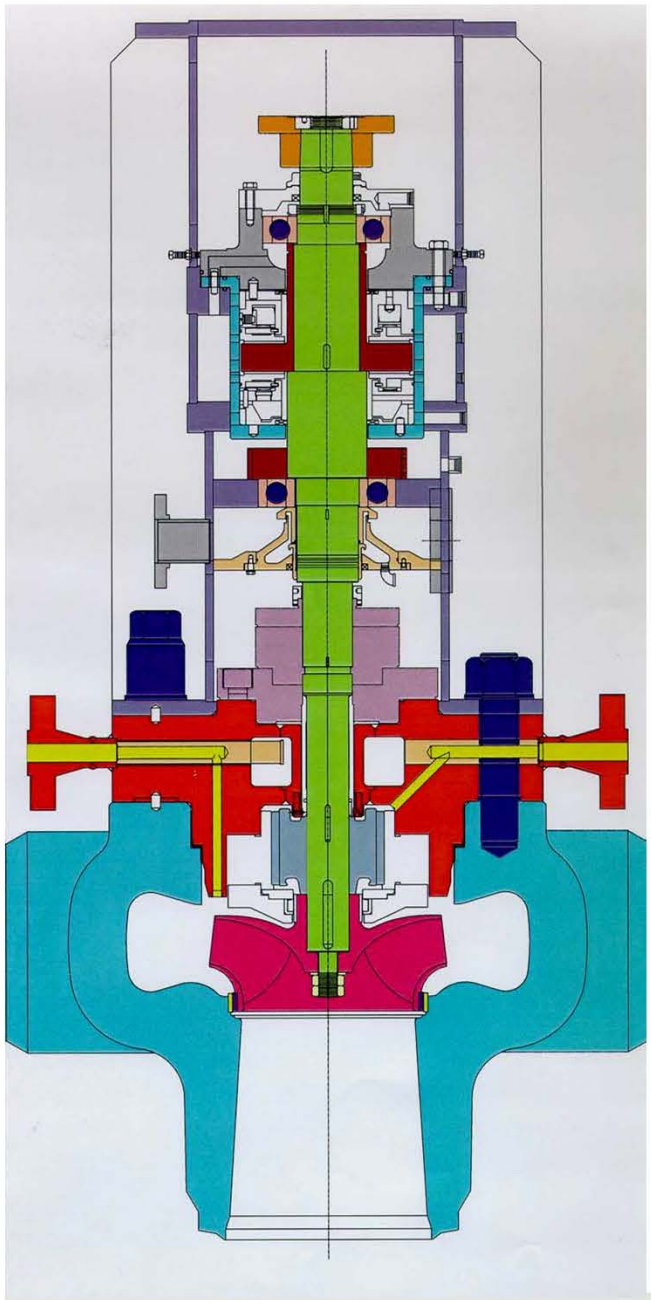
2. Due to the high temperature of the feed water and significant frictional heat of the seal faces, water temperature must be reduced to below 150˚F in order to sustain adequate lubrication of the seal.

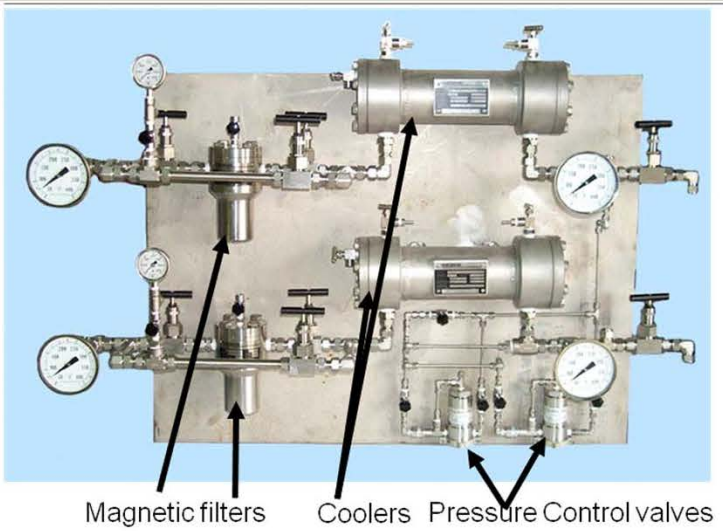
3. When the pump is operated in hot stand-by, the water temperature must be maintained below the elastomer temperature limit.

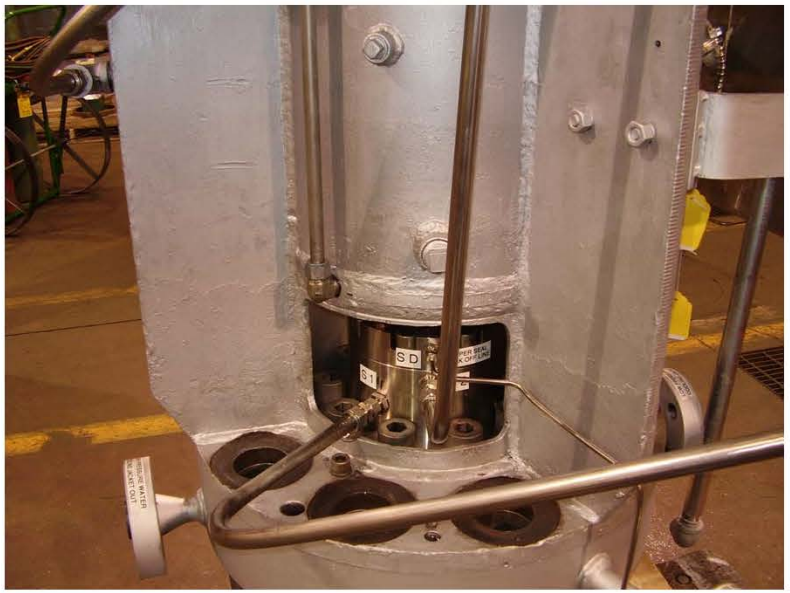
4. Internal journal bearing still needs lubricated with cooled feed water despite elimination of water injection system.

5. New system must be compact to facilitate future retrofits

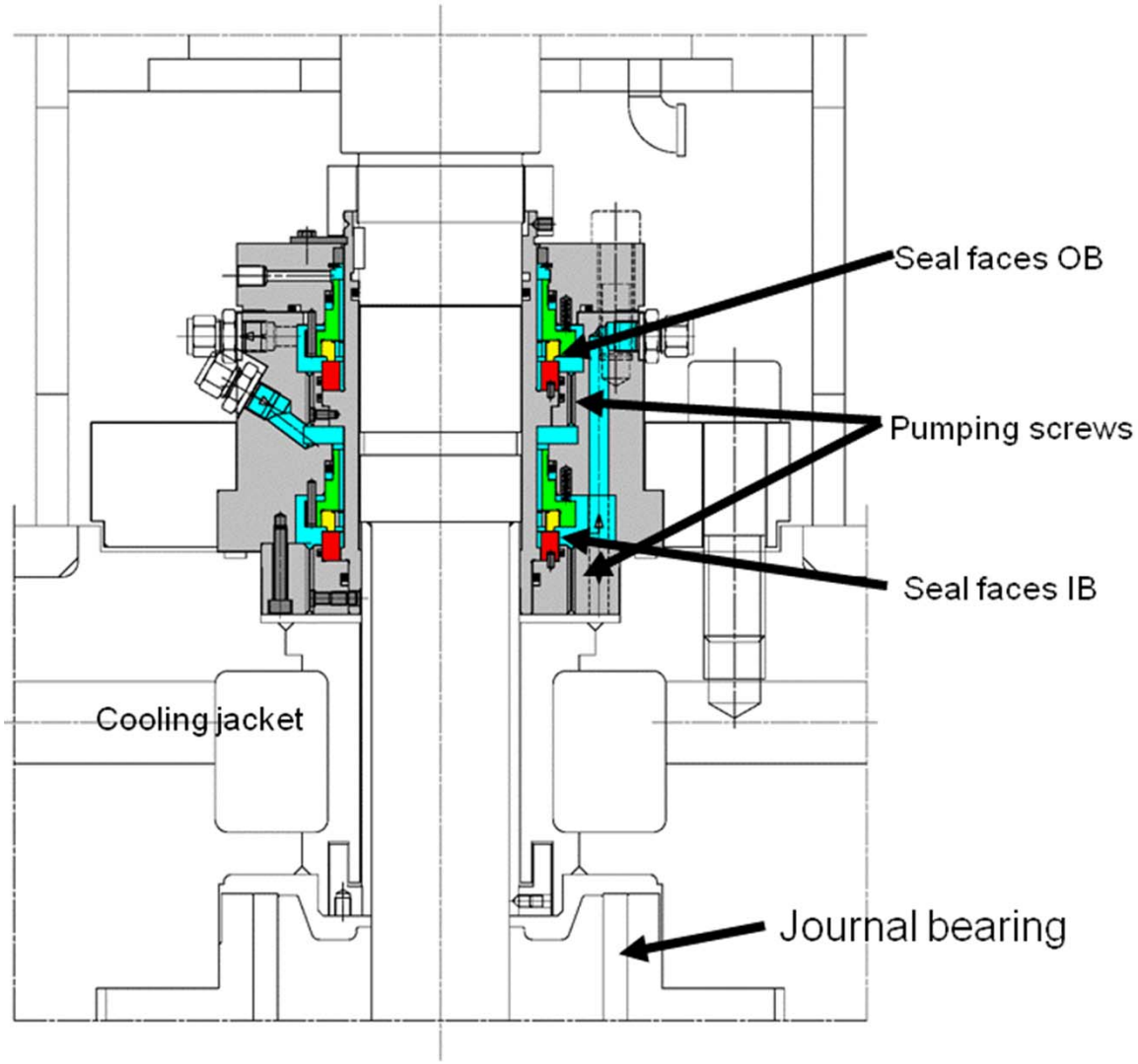
SEALING SYSTEM SOLUTION







SEALING SYSTEM SOLUTION



Soft carbon faces are shrunk fit in stainless steel housings

Installation of the control panel on the pump frame in the workshop

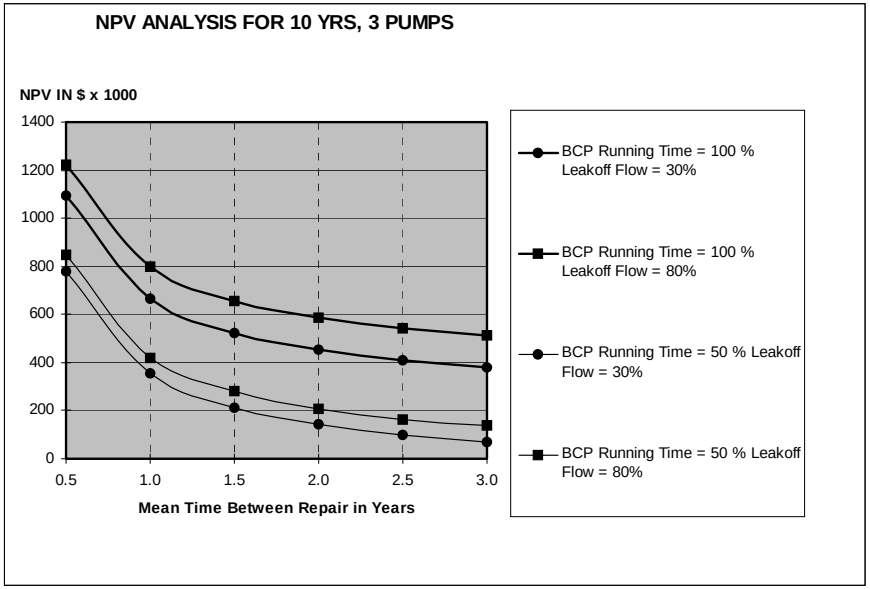
This mechanical sealing system requires virtually no maintenance and start up procedures are relatively simple, minimizing the potential for infant type failures.

BENEFITS TO END USERS:

- Significant cost savings regarding energy and maintenance conservation, resulting in lower life cycle cost of boiler circulating pump.
- Simplification of operational procedures and improved safety for operator personnel.
- Reduction of stress levels in pump components.

Return on investment model for economic justification

	UNIT	1999 A	B	C	TOTAL	
FLOW OF BOOSTER PUMP	GPM				120	
% TO BCP	%	33%	33%	33%	100%	
	GPM	40.0	40.0	40.0	120	
DELTA T OF COOLER 67	F				60	
% INJECTION FLOW TO SEAL LEAKOFF	%	80%	80%	80%	80%	
	GPM	32	32	32	96	
% INJECTION FLOW INTO BCP	%	20%	20%	20%	20%	
	GPM	8	8	8	24	
SEAL LEAKOFF FLOW OF BOOSTER PUMP	GPM	3.3	3.3	3.3	10	
TEMPERATURE OF INJECTION WATER AT DEAERATOR	F	340	340	340		
TEMPERATURE OF INJECTION WATER AT SEAL LEAKOFF	F	350	350	350		
TOTAL SEAL LEAKOFF FLOW TO DEAERATOR	GPM	35.3	35.3	35.3	106.0	
RUNNING TIME OF BOOSTER	%/YR				100%	
	hr/YR				8760	
RUNNING TIME OF BCP	%/YR	100%	100%	100%	100%	
	hr/YR	8760	8760	8760	26280	
COST OF ELECTRICAL POWER	$/kwh				0.025	
COST OF THERMAL POWER	$/F*Ga				0.000022	
COST OF HEATLOSS IN COOLER 67	**$x1000**	**30.1**	**30.1**	**30.1**	**90.2**	51%
COST OF HEAT LOSS IN SEAL LEAKOFF	**$x1000**	**4.1**	**4.1**	**4.1**	**12.3**	7%
MTBF OF FLOATING RING SEALS	YR	2	2	2	2.00	
AVERAGE LABOR COST/FAILURE	$				2500	
AVERAGE PARTS COST/FAILURE	$				22500	
AVERAGE FAILURE COST/YR	**$*1000**	**12.5**	**12.5**	**12.5**	**37.5**	21%
AVERAGE MAINTENANCE COST BOOSTER PUMP/YR	**$x1000**	**1.7**	**1.7**	**1.7**	**5.0**	3%
POWER OF BOOSTER PUMP	Kw				14.7	
POWER COST OF BOOSTER PUMP/YR	$*1000				3.2	
QTY OF BCP RUNNING OF BOOSTER?	0/1	1	1	1	3.0	
POWER COST OF BOOSTER PUMP/YR*UNIT	**$*1000**	**1.1**	**1.1**	**1.1**	**3.2**	2%
POWER COST TO INCREASE LEAKOFF FLOW BACK TO 3000 PSI	**$*1000**	**9.7**	**9.7**	**9.7**	**29.0**	16%
TOTAL POWER COST /YR	$*1000	**44.9**	**44.9**	**44.9**	**134.7**	
THERMAL		**34.1**	**34.1**	**34.1**	**102.4**	
ELECTRICAL		**10.8**	**10.8**	**10.8**	**32.3**	
TOTAL MAINTENANCE COST		**14.2**	**14.1667**	**14.2**	**42.5**	
TOTAL OPERATIONAL COST/YR	**$*1000**	**59.1**	**59.1**	**59.1**	**177.2**	100%



BENEFITS TO END USERS:

- Elimination of injection pump, boiler feed system extraction and greatly reduced piping support.
- Elimination of seal injection control problems.

QUESTIONS?