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NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-NLO-002-310-2-01 Revision 1

TITLE: PUMP AND VALVE FUNDAMENTALS

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Summary of Pages

(Effective Date: 2/5/91)

Number of Pages: 33

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January 1991	1 - 33

TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY:

VERIFICATION:

DATA ENTRY:

RECORDS:

MASTER CONTROLLED DOCUMENT

I. <u>TRAINING DESCRIPTION</u>

A. Title of Lesson: Pump and Valve Fundamentals

B. Lesson Description:

1. Instruct trainee in construction, theory and operation of pumps and valves with emphasis on operational considerations such as position verification of valves and concerns of related industry events. 1

C. Estimate of Duration of the Lesson: 10 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Written exam passing grade of 80% or greater

E. Method and Setting of Instruction: This lecture/facilitated discussion should be conducted in the classroom. Maintenance labs may be used for 'hands on' exposure to pump and valve internals.

F. Prerequisites:

1. Instructor:
   a. Certified in Accordance with NTP-16.
2. Trainee:
   a. In accordance with NTP-12.

G. References:

1. NAVEDTRA 10520-G (Fireman)
2. NAVPERS 16193-B (Fluid Power)
3. NAVPERS 10788-B (Principles of Naval Engineering)
4. U-2 Operations Technology - Mechanical Fundamentals
5. NMPC/General Physics Corp - Reactor Analyst Technician Training. 1
6. Power Safety International - Pump Maintenance Training Course.

II. <u>REQUIREMENTS</u>

A. Requirements for Class:

1. INPO NLO Guidelines
2. NTP-12 1

B. Specific Content:

1. SOER 83-9
2. SOER 84-7
3. IN 83-55

III. TRAINING MATERIALS [(*) optional]

A. Instructor Materials:

1. Whiteboard, markers, erasers
2. Transparencies (Appendix A) 1
3. Overhead Projector
4. Working Copy of this OLP
5. Handouts
6. Student Text
7. ITC 1/2" Video "Reciprocating Pump Operations" (*) (Appendix B) 1
8. ITC 3/4" video "Centrifugal Pumps" Operations (*) (Appendix B)
9. NUS 1/2" Video "Centrifugal Pump Maintenance" (*) (Appendix B)
10. TV and video players (*)
11. Copy of ANSI B95.1 - 1977 1
12. Training Record (TR)

B. Trainee Materials: 1

1. Text (U-2 Ops. Tech. Mechanical Fundamentals)
2. Pens, pencils, paper
3. Binders (*)
4. Course Evaluation Forms

IV. EXAM AND MASTER ANSWER KEYS

A. Exams and answer keys will be on permanent file in the Records Room.

V. LEARNING OBJECTIVES

A. Terminal Objectives:

Upon satisfactory completion of this lesson the trainee will demonstrate the knowledge to: 1

TO-1.0 Accurately determine the position of valves.

TO-2.0 Identify improper pump and valve operations.

TO-3.0 Operate pumps and valves.

TO-4.0 Operate a hydraulically operated valve. (2989120104)

TO-5.0 Operate a Motor Operated Valve (MOV). (2989130104)

TO-6.0 Assist in Inservice Inspection (ISI) of pumps. (2989150104)

TO-7.0 Perform valve operability checks. (2980170204)

TO-8.0 Perform check valve operability verification. (2980180204)

TO-9.0 Assist in valve Inservice Inspection Tests (ISI/IST). (2980210204)

TO-10.0 Operate a Solenoid Operated Valve (SOV). (2989060104)

B. Enabling Objectives:

EO-1.0 List the two categories of pumps.

EO-2.0 Explain the basic operation of each type of pump.

EO-3.0 Identify the major components of a pump.

EO-4.0 State the purpose/function of major pump components.

EO-5.0 Define the following pump terms:

a. head
b. suction head
c. suction lift
d. discharge head
e. NPSH
f. cavitation

EO-6.0 State the pump laws.

EO-7.0 Describe the difference portions of a pump/system operating curve.

EO-8.0 List four of the six types of valves used at NMP2.

EO-9.0 Identify the major components of a valve.

EO-10.0 State why gate valves are not normally used for regulating (throttling) flow.

EO-11.0 Describe the construction and operation of a Motor Operated Valve (MOV).

EO-12.0 Describe the construction and operation of a hydraulically operated valve.

EO-13.0 Describe the construction and operation of a solenoid operated valve (SOV).

EO-14.0 State the operational considerations for the operation of manual valves.

EO-15.0 Describe thermal effects that are associated with gate and globe valves.

EO-16.0 Describe the hydraulic effects associated with gate valves.

EO-17.0 Describe the correct method to verify the position of manual valves.

EO-18.0 List the preoperational checks required when starting a pump.

EO-19.0 Explain why packing should not be tightened with a valve shut.

EO-20.0 Describe the correct method of adjusting valve packing.

EO-21.0 Describe the correct method of adjusting pump packing.

EO-22.0 State the purpose of performing Inservice Inspections and tests.

EO-23.0 State the responsibilities of the Operations Department in the Inservice Inspection and Testing Program (ISI/IST).

EO-24.0 State the responsibilities of Operators performing Specific Operations Surveillance Procedures (OSP).

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
I. INTRODUCTION	1. Distribute TR	1
A. This lesson provides instruction on pump and valve theory, construction and operation.	2. Distribute/explain course evaluation 3. Review method of trainee evaluation 4. Preview Enabling Objectives	

II. FLUID FLOW CONCEPTS

A. General Energy Equation

1. States that all the energy in a system remains constant.

   E total = PE pressure + KE velocity + E other
   (HT of H_2O) (heat)

   Consider E other constant... an increase in PE will cause a decrease in KE.

2. Within a system or a pump, an important consideration is the volume of flow per unit time, or volumetric flowrate ($\dot{V}$)

   $\dot{V}$ = AV

   $\dot{V}$ = Volumetric Flowrate

   A = Area, Ft^2

   V = Velocity, Ft/Sec.

3. For a closed section of a system, such as the space between the suction and discharge of a pump, the volume in is equal to the volume out.

   $\dot{V}_{IN} = \dot{V}_{OUT}$

   a. Since $\dot{V}$ is constant within a section of piping or system, if area (A) increases then velocity (V) will decrease.

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
b. The change in velocity caused by the change in area will cause pressure to change.	See Attachment 1	1
III. PUMPS		1
A. Definition of a Pump		
1. Device which transforms energy into pressure.		
2. Increases the energy of a fluid.		
B. Two Categories	Show (TP-2)	EO-1.0 1
1. Kinetic		EO-2.0
a. Accelerate Fluid and use KE to move fluids and increase pressure.		
2. Positive Displacement	Two objects cannot occupy the same space at the same time.	
a. A device (piston, plunger, gear, etc.) positively displaces (takes up the same space) fluid in a cylinder.		
C. Classification	In addition to category	
1. Used to describe pumps - many methods		
2. Internal components	- Volute, diffuser, piston, plunger	
3. How force is applied to the fluid	- Rotary, reciprocating, piston, plunger, diaphragm, etc.	
4. How many pressure steps (stages) are required	- single stage, ... 6 stage	
5. Type of Driver and Position of Shaft	- Motor, turbine, horizontal, vertical	
6. Flow	- Radial, axial, mixed	

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES	
D. Components	Describe what this heading means (Description of major components to allow further discussion).		
1. Impeller a. Internal component driven by the pump source.	Show (TP-15) and use it to describe the following components. Point out impeller. Usually associated with centrifugal pumps.	EO-3.0 EO-4.0	|1
b. Adds motive force (velocity or KE) to the fluid.	The term can be used to describe a pump part that rotates (Websters - rotor).		
2. Casing a. Housing that contains the fluid and the devices that convert energy into pressure.			
3. Stuffing Box (Packing Gland) a. Penetration for the shaft to pass through	Point out Packing Gland. Note that the same will exist on pumps. Move info. on operations sections of lesson.		|1
4. Wear Rings a. Renewable rings installed to separate the HP from the LP side of the impeller.	Point out Wear Rings.		|1
b. May be installed on the impeller, casing, or both.			

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
E. More definitions associated with pumps		
1. Head - Pressure	Describe what this heading means. Show (TP-7A). Explain the term.	EO-5.0 |1
2. Suction Lift	Show (TP-7A) and explain.	EO-5.0 |1
a. Vertical distance from of pump to the free level of the liquid to be pumped.	Associated with conditions where the pump is located <u>above</u> the fluid.	|
3. Suction Head		
a. Vertical distance from C of pump to the free level of the liquid to be pumped.	Associated with conditions where the pump is located <u>below</u> the fluid.	
4. Discharge Head		
a. Total number of feet a pump will move a liquid in a pipe.	Point out that centrifugal pumps' disch. head is usually expressed in feet of head whereas positive displacement pumps are in PSI.	
5. NPSH		EO-5.0 |1
a. Difference in saturation pressure of the fluid and the pressure of the suction of the pump.	Use a drawing to show varying suct. head - lead into a condition where vapor is formed (cavitation).	|1 |
6. Cavitation	(Optional - show Centrifugal Pump Maint. tape up to 216 ft.)	
a. Rapid formation and collapse of vapor bubbles in a pump or system.		|1
b. Causes extreme damage to pumps.		|

7. Air Binding		|1
a. Build up of vapor or gasses in a pipe or pump which can actually prevent flow.	Purpose of high point vents.	
8. Water Hammer		
a. Piping system term used to describe the 'loud' effect that pressure transients caused by a rapid change in flow in a piping system.	Caused by rapidly closing a value.	
9. Run Out		
a. Pump term used to describe the condition of excessive flow (beyond design which could cause high current and therefore motor winding damage.	Caused by low downstream pressure from an unfilled leg, pipe break, decrease in fluid density etc.	
F. Pump Characteristics	Describe what this heading means (i.e. pump laws, pump curves, system curves, operating curves).	
1. Pump Laws	Point out that pump laws are:	EO-6.0 |1
a. Pump capacity varies as the change in speed.	- Theory	
1) $N_{Speed} \propto \dot{V}_{Flow}$	- Apply to radial flow centrifugal pumps	|1

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
	Write laws on board and work through some examples both increasing <u>and</u> decreasing pump speed.	
b. Pump head (pressure) varies as the change in speed squared.		
1. $N_{Speed}^2 \propto H_{P_{head\ pump}}$	Point out that increasing speed from 1800 to 3600 changed speed by a factor of 2, not 1800.	|1
c. Pump power varies as the change in speed cubed.		
1. $N_{Speed}^3 \propto P_{power}$	Help students understand laws by addressing head vs. power or flow vs power etc.	|1
	Write pump law proofs on board and review.	
2. Pump Curves		EO-7.0 |1
a. Used to describe a pump's pressure and flow relationship at <u>one</u> particular speed.	Draw curves on board.	
	Explain the axis and the relationship of these curves with pump laws.	|1
3. System Curves	Draw onto pump curves.	
a. Used to describe a system's pressure and flow relationship.	Point out operating point(s). Demonstrate changes in flow due to	
b. Change as resistance changes.	throttling vs. changing speeds.	

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
G. Pump Types	Describe what this heading entails (description of various types of pumps, major differences, and how they work).	
1. Centrifugal	Show (TP-7).	
a. Most common	Explain how it works.	
b. Radial flow 1. Have volutes or diffusers to convert velocity into pressure.	Emphasis that with kinetic pumps if no flow - energy is being converted into heat (lead students to this conclusion via general energy equation).	
c. Axial Flow (Propeller)	Show (TP-5A).	
1. Not a 'true' centrifugal pump	Explain how it works.	
2. Moves fluid like a 'fan' does		
3. Large vol. but low pressure		
d. Mixed Flow		
1. Uses both radial and axial flow to move fluid.		|1

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
2. Develops more pressure than an axial flow pump but less than a radial flow pump.	If available take trainees to Mech. Maint. lab. and touch, feel a centrifugal pump.	1
E. Jet Pumps	Show (TP-25) and explain how it works.	
1. Area decreases - velocity increases		
2. Fast flowing fluid entrains molecules and creates a LP area.	Emphasize this is a major advantage.	
3. No moving parts.		1
4. Ejectors a. Use gases (steam or air) vs liquid.		
5. Eductor a. Use liquid (water) vs. steam or air.		
	Explain that the previous four types all use kinetics (velocity) to create a DP which causes fluid flow. The remaining pumps are positive displacement.	
2. Positive Displacement (Rotary and Reciprocating)	- Review Principle of Positive Displacement. - No two objects can occupy the same space at the same time.	

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
a. Rotary		
1) Gear Pump	Show (TP-21) and explain how it works.	
a) Gears mesh.		
b) Liquid is trapped in 'pockets' formed by the teeth and casing and is displaced (moved) in a 'rotary manner'.		
c) Spur gears	Show (TP-22) and explain the differences.	
d) Helical gears		
e) Herringbone gears		
2) Screw Pumps	Show (TP-20) explain how it works.	
a) Intermeshing 'screw's		
b) A 'pocket' is formed and the fluid is displaced (moved) in a 'rotary manner'.		
3) Sliding/Moving Vanes	Show (TP-23) and explain how it works.	
b. Reciprocating	Explain how it works.	
1) A piston, plunder or diaghragm moves back and forth.		
2) The piston or plunger displaces (moves) the fluid on each stroke.		
a) Each stroke delivers a 'set' amount.		

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
b) Single acting i) Displacement takes place on every other stroke.	Explain the difference.	
c) Double acting i) Displacement takes place on each stroke.	Show TP-23 and use it to review other types of positive displacement pumps.	|1
IV. VALVES - THEORY		
A. A valve is a device for stopping and/or controlling the flow of a fluid (liquid or gas)through a pipe or an opening.	Stress that all systems are started/ started and controlled by positioning of valves.	
B. Valve designs vary greatly due to the many tasks valves perform in a powerhouse. Therefore, valves are classified as: 1. Gate valves 2. Globe valves 3. Check valves 4. Butterfly valves 5. Safety and relief valves 6. Ball 7. Plug	If available - obtain examples of these valves to pass around for trainees to touch, disassemble etc.	EO-8.0 |1

C. Valve Components

Indicate various parts on TP as they are discussed. Show (TP-V-1).

1. Features vary due to pressure of fluid to be pumped and material of construction. However, parts of valves must perform the same function.

Briefly describe the major components then return to this section and cover in more detail.

a. Valve body

EO-9.0

1. The body forms the major part and outline of the valve. It supports all other valve parts. The valve body contains the valve seat that receives the valve disk to close off all flow. The body is constructed so that when the valve is completely assembled, the valve will prevent system leakage whether open or closed. The valve body is connected to the system by bolting (flanges), threading (screwed connection), or welding it to inlet outlet piping.

b. Valve bonnet		
1. The bonnet is the closure head on the valve body. Without a bonnet and other internals discussed below, the valve body is merely a cavity containing the seat surface. The valve bonnet supports the stem, disk, and the actuator. The valve bonnet is connected to the valve body by bolting, threading, or welding.		EO-9.0 |1
c. Valve Stem & Stuffing Box		
1. The stem moves the valve disk in and out of the valve seat. Valve stem motion may be manual (hand-wheel or bar) or provided by power (electric, hydraulic, pneumatic).	Explain how packing is installed Emphasize that with continued use of a valve, the stem will gradually wear the packing away and a leak may develop.	EO-9.0 |1
Since the valve stem must pass through the valve bonnet to raise and lower the disk in and out of the seat, a means to prevent fluid leakage is required. To ensure little or no leakage, packing was developed. Packing is placed in the stuffing box or space that surrounds the valve stem and is held in place by a packing gland.	Display (TP-11) to explain the above. Display (TP-6) to aid in the above explanation.	|1

d. Valve Disk EO-9.0 |1

1. The disk provides the capability to regulate or stop system flow through the valve. System flow is stopped when the disk is inserted into the valve seat. The disk is attached to the valve stem.

e. Valve Seat EO-9.0 |1

1. The seat forms the other half(with the valve disk) of the closure surface to stop system flow. As mentioned earlier, the valve seat is in the valve's body. In some valves, the body itself is machined to provide a seating surface. In other valve designs, the valve seat is screwed or welded into the valve body. In any case, the valve seat must be very smooth and hard to prevent leakage and resist wear.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES	
f. Valve Actuator			
1. The actuator (operator) moves the stem in and out of the valve seat. The actuator may be a handwheel, bar, or power operator. The actuator may be supported by the stem itself (handwheels and bars), or the actuator may be supported by the valve bonnet (power actuators).	Explain the three types.		
D. Types of Valves			
1. Gate Valve	Show (TP-6B/C) and indicate valve parts on TP.		1
a. The major parts of a gate are body, bonnet, stem, and seat rings. The gate valve is raised or lowered by rotating the valve actuator. The gate valve is raised or lowered by rotating the valve actuator. The gate is lowered into the flowpath to stop flow. The gate is lifted out of the flowpath to allow flow. The gate is forced against the valve seats as the valve is closed, thus providing a tight seal. When the valve is fully open, the gate is out of the flowpath and does not obstruct the flow.	Explain why gate valves are not used for throttling by demonstrating how flow will erode seat.	EO-10.0	1

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
2. Globe Valves	Show (TP-8, 8A) and explain why globe valves are used for throttling. "No rough edges to erode"	1
a. The globe valve consists of a disk that is forced into a tapered seat. The angle used and the taper of the disk and seat vary with valve size and the kind of services to which the valve is applied. Globe valves are used when the flow is to be regulated or throttled.	Demonstrate how globe valves can be designed to be assisted open or close by pressure of fluid.	
b. Some globe valves are specially designed to have flow throttled.	Emphasize that although most any valve can be throttled - some are better suited than others.1 - minimize cavitation, erosion - fine control Recognize that when things start clanging and chattering that some thing is wrong.	1

3. Check Valves

a. Check valves are designed to permit flow in one direction only. If system flow stops or reverses, the check valve closes. Check valves are extremely important to proper functioning of any piping system because of (1) their quick automatic action (2) their sensitivity to changes in flow conditions. Three basic types of check valves are swing-check, lift-check, and stop-check valves.

1) Swing Check Valve

a) The swing check-valve has a hinged disk that swings when operating. Swing check-valves offer little resistance to flow when open.

Explain how check valves are used to prevent dangerous backflow in a line when two or more fluids are being supplied to a common point at different pressures and to prevent over pressurization of equipment.

|1

Show (TP-14).

Indicate on overhead how swing check is out of flowpath. Explain how a swing check that is open for long periods of time (extraction steam lines) may try to stick open, therefore, where closing is important. a closing assist mechanism is used.

2) Lift Check Valve — Show (TP-10) and explain how it works. | 1

a) In the lift check valve, the disk (plug) is attached to slide or raise on a fixed stem. The disk is free to open or close with no stem motion. The valve disk "lifts" off the seat when the flow is from inlet to outlet. When the flow is reversed, the disk seats, preventing flow.

3) Stop Check Valve — Show (TP-V-9) and explain how it works.

a) A special application of the check valve is the stop check valve. When the stem is withdrawn, the disk is free to lift or close, depending on the direction of flow, just as in any typical check valve. After system flow through the valve is stopped, the stem is inserted in the disk by turning the valve actuator in the close direction.

When the stem is inserted in the disk, it forces the disk tight against the seat. In this position, the valve serves as a stop valve. Flow is stopped in either direction.

4. Safety and Relief Valves
   a. Both are devices used to protect systems from overpressure.
   b. Safety Valves
      1) 'Pop' open fully
      2) Ideal for gases (compressibles)
      3) Stay open (relieve pressure) until a set pressure is reached.
   c. Relief Valves
      1) Open in proportion to the pressure applied
      2) Ideal for liquids (noncompressibles)
      3) A large energy (pressure) reduction with a little liquid.

Compare features/differences between Safety and Relief Valves.

d. In general, a relief valve consists of a valve body, a disc, and a stem. A spring pushes down on the disc to keep the valve closed. The spring tension is usually adjusted by tightening or loosening a nut/bolt on top of the spring. As pressure overcomes, spring tension the valve starts to open, etc.

Show (TP-10B) and point out parts.

e. A safety valve has a large disc area exposed to pressure. This causes the valve to open fully. An even larger surface area is exposed once the disc starts flow.

E. Valve Operators

1. Valve operators (actuators) move the valve stem, and thus the disk in and out of the valve seating area. The following valve operators are discussed in this chapter.

Review ANSI B95.1 - 1977 'Terminology for Pressure Relief Devices' to describe the difference between a safety and a relief valve. 1

a. Manual operators
b. Electrical operators
c. Pneumatic operators
d. Hydraulic operators

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
2. Manual Operators a. Manual operators can adjust a valve to any position. Handwheels are directly attached to the valve stem. The size of the handwheel provides the only mechanical advantage. When a valve's location does not permit easy access to the handwheel, chain wheels or reach-rods may be used.	Explain to Trainee about hammer valves and reduction gears. Emphasis "lefty" "loosey" "righty" - "tighty" "Not Always"	|1 |1
3. Electrical Operators Motor Operated Valves a. Electric motors are fitted to valves throughout the plant. Electric motor operators have a control and switching box, a drive motor, a handwheel for manual operation, an operating shaft, a gear box, and limit switches. The limit switches open and close the valve and indicate valve position (usually by red and green lights) in the Control Room.	Display (TP-20A, 20B, 20C, 20D) and Explain both motor and manual operation of limitorque valve. Place special emphasis on remote operation of MOV. "Pump start contact closed and MOV opens" (Optional - Use MOVs in Electrical Maint. Shop as training aids.) (Do this sometime, not necessarily now, let ea. trainee manually operate a Motor Operator).	EO-11.0 |1 |1

4. Pneumatic Operators

   a. Pneumatic (diaphragm) operators control valve stem movement by using the energy of compressed air. Pneumatic operators generally control or regulate flow, but are also used in simple open/closed applications. Diaphragm actuator units generally consist of a sealed casing, diaphragm, spring, and shaft (valve stem or extension). Air can be supplied either above or below the diaphragm, depending on whether the air is to open or close the valve. A solenoid valve controls the air supply. The operator positions a switch to energize the solenoid, and air is admitted to the diaphragm and the valve opens. When the solenoid is de-energized, air is vented from under the diaphragm and the spring closes the valve.

Show (TP-26A, B, 27) and explain to Trainee how AOVs can be "fail open" or "fail closed" on loss of air or electrical signal and how to determine which by looking at the valve.

5. Hydraulic Operators

   a. Hydraulic valve operators convert fluid pressure into valve motion. EO-12.0

   b. High pressure fluid remotely directed to and exhausted from the top and bottom of a cylinder provides for valve piston travel to open/close the valve.

c. Piston may be directly attached to valve stem...or work through rams or levers.		
6. Solenoid Valves		EO-13.0
a. Often used to control the flow of air through a system (or to an AOV).		
b. The solenoid is a coil which produces a magnetic field when energized.		
c. The magnetic field draws a metal slug up into the coil to open the valve.		
d. This valve is either fully open or fully shut...not used for throttling.		
7. Butterfly Valves (TP-16)	Show indicated TP to help describe the valves.	
8. Ball Valves (TP-18)		
9. Plug Valves (TP-17A, B)		
10. Double Disc Glove Valvor (TP-19)		
V. OPERATIONAL CONSIDERATIONS	Point out that AP-4.0 and ODI 5.08 both govern pump and valve operations.	
A. Valve Manual Operation		
1. Use two hands (depends on design).	Discuss handwheel size.	EO-14.0
2. Do not use 'cheaters'.		
a. Impact of over torque		
1) Component failure		
2) System failure		
3. Shut snugly unless specifically directed to do otherwise.	Describe the following to aid in understanding.	
4. Do not backseat unless specifically directed to do so.	- Seating surfaces of seat and disc - Back seats	

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
5. Maintain positive control when initiating flow.	- Reason for 1/4 turn in shut direction	
6. Open fully - then move handwheel in the shut direction 1/4 turn.		
7. Pressure and temperature limitations.	Be aware that all components have limitations. Sever rattling could be an indication that a valve is exceeding a flow limit. Review other similar scenarios that are related to design limitations such as pressure, dp etc.	|1
8. Hammerblow effect		
9. Reach rod		
a. Check valve stem where possible.	Explain the differences between thermal effects on gate vs. globe valves.	EO-15.0 |1
10. Thermal effects		
a. Gate valves are pinched shut.		
b. Globe valves come off the <u>shut seat</u>.	Stress that if you know how a valve is built, or works, it should come as no surprise that these effects should happen.	|1
		EO-16.0 |1
11. Hydraulic Effects	Describe hydraulic effects.	
a. Gate valve bonnets can become pressurized and: 1) Hold the value shut 2) Crack the bonnet 3) Hurt personnel		

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
B. Valve Position Verification		EO-17.0 |1
1. Use every means available and authorized to convince yourself of the position of the valve.	Stress how knowing 'how a valve works' can be coupled with these physical methods to determine the position of a valve.	
2. Rotate the steam in the 'shut' direction enough to demonstrate the valves position.		
a. If there is movement in the shut direction, the valve is <u>probably not shut</u>.		
b. If no movement in the shut direction, the valve is <u>probably not open</u>.		
3. Locked or throttled valves	Do not 'unlock' a lock to check its position.	
a. Valves with a lock or anti-tampering device should not be physically rotated unless specific direction is given to do so.	Describe throttle settings.	
b. Only required to check that the device is installed and intact.	Always consult the SSS if problems arise.	|1
	If available take trainees to Mech. Maint. lab. and have them 'check the position of valves".	|1
c. Valve Line Ups	Covered in detail during make up training.	|
1) Use position verification methods.		|
2) Use positioning methods.		|

LESSON CONTENT	DELIVERY NOTES	ECTIVES/ NOTES
3) Refer to ODI 5.08 or Control Room when in doubt.		
4) In all cases...contact the Control Room if a valve is found out of position.	Stress this item.	
VI. PUMP OPERATION CONSIDERATION		
A. Pre-operational checks	Write on the board or display prepared flipcharts.	EO-18.0
1. Coordinate with Control Room		
2. ID the pump		
3. Inspect the Pump and Driver		
4. Check the Lubrication System		
5. Check instrumentation		
6. Conduct valve line-ups as required		
7. Coordinate with Control Room		
B. Start Up		
1. Coordinate with Control Room		
2. Maintain positive control and start pump		
3. Observe all available parameters		
4. Check for unusual noise, odor, vibration etc.		
5. Inspect the packing		
6. Coordinate with Control Room		
C. Operational checks		
1. ID the pump		
2. Instrumentation		

3. Inspect packing and seals		
4. Inspect Lubrication System		
5. Inspect motor, pump visually, odor, sound, etc.		
VII. Maintenance Considerations		
A. Extent is minor adjustment of packing leakage on pumps and valves.	Stress that the consequences of improper adjustment must be weighed prior to adjustment.	
B. Write work requests for those items beyond the ability/authority of Operators.		
C. Valve Packing Adjustment	Effects on - stroke times - component capabilities - Reactor safety - etc.	EO-19.0 |1
1. Coordinate with Control Room.		
2. Adjust only with the valve 'open' (off of shut seat).		
3. Adjust evenly - one flat at a time maximum.	Define a flat.	EO-20.0 |1
4. Cycle the valve if possible.	Define 'two-blocked' Explain that cycling helps to <u>seat</u> the packing.	|1
5. Repeat as required the adjust and cycle steps.		
6. Notify the Control Room when adjustments are completed.		
D. Pump Packing Adjustments		EO-21.0 |1
1. Coordinate with the Control Room.		
2. Ensure the pump is running.		

3. Use the appropriate tech. manual or engineering group to determine proper leak rate or techniques to use.
4. Adjust packing evenly - one flat at a time maximum.
5. Wait and observe packing 15 min. minimum.
6. Repeat the adjust/wait steps as required.
7. Notify the Control Room when completed. 1

VIII. Inservice Inspection (ISI) and Inservice Testing (IST).

A. ISI/IST Program

1. Comprehensive plans which ensure the structural integrity and operational readiness of certain systems, components and component supports. EO-22.0
2. AP-8.3 identifies the coordination and implementation of the program.
3. Nine Mile Point Surveillance Tests are the mechanism by which Site Engineering ISI/IST obtains, analyzes and trends IST Program Plan required parameters.
4. Operations Department Responsibilities (some) EO-23.0
   a. Perform tests and record data.
   b. Perform initial analysis of recorded data following each test.

c. Transmit data pertaining to ISI/IST components to Site Engineering ISI/IST.

d. Declare a component INOP when Procedure criteria and Test data determine component UNSAT.

B. Perform a Valve Operability Test

1. Obtain an applicable OSP. (Example: N2-OSP-DFR-Q001 Drywell Floor Drain Valve Operability Test) EO-24.0

2. Review the sections of the OSP.

a. Purpose

b. Precautions and Limitations

c. Prerequisites

d. Plant Impact

e. Procedure

f. Signature Log

3. Discuss the responsibilities of the Operators involved.

C. Perform A Check Valve Operability Verification EO-24.0

1. Obtain an applicable OSP (Example: N2-OSP-ICS-Q002 RCIC Pump and Valve Operability Test and System Integrity Test).

2. Review the sections of the OSP.

3. Discuss the responsibilities of the Operators involved.

D. Assist In Inservice Inspection (ISI) of Pumps EO-24.0

1. Obtain an applicable OSP (Example: N2-OSP-CSL-Q002 LPCS Pump and Valve Operability and System Integrity Test).
2. Review the sections of the OSP.
   a. Pump Operability Test Sect. 8.1, page 6.
3. Discuss the responsibilities of the Operators involved.

IX. REVIEW

A. Review key headings of lesson.
B. Review objectives.
C. Ask/answer questions.