NORTHWEST TERRITORIES POWER CORPORATION

# Taltson Hydro

## Operations, Maintenance and Surveillance Manual

**March 2013**

# Index

# 1 General

The potential for hydro development on the Taltson River was first recognized in 1916 by Charles Camsell, a geologist employed by the Government of Canada, later commissioner of the Northwest Territories, who noted:

> *"The combination of numerous lakes, acting as reservoirs, with water falls and streams makes the whole Taltson river System an excellent one for the development of water power."*

In the late 1920's the discovery of the rich lead zinc deposit at Pine point prompted a renewed interest in hydro power in the area. This was followed up in 1929 when Consolidated mining and Smelting (CM&S) engaged H.G. Acres, hydro engineering consultant, to investigate potential sources of hydro supply for Pine Point Mine. After reconnoitering Smith rapids on the Slave River and Alexandra Falls on Hay River, Acres turned his attention to the Lower Taltson River. He appears to have travelled up the Taltson to at least as far as Nende Rapids. On this trip he established a flow gauging station on the Taltson River about 2.0 km upstream of the junction with Tethul River. Sporadic measurements were taken at this gauging station during the period August 1929 – February 1931, including the first use of aircraft in winter time in support of a flow measurement program. Interest in Northern mining ventures lagged during the economic crisis of the late 1920's and 1930's leading to the abandonment of this gauging station in 1931.

It wasn't until the 1950's that there was a significant revival of interest in developing Pine Point Mine and related hydro supplies. A result of this renewal of interest was the decision by CM&S in 1952 to establish a flow gauging station at the outlet of Tsu lake (19 km upstream of Acres' gauge). This gauge operated between 1952 and 1954 and was later reactivated in 1960 in response to the requirements of NCPC ( Northern Canada Power Commission, predecessor of NTPC). The first comprehensive evaluation of the hydro potential of the Taltson River was carried out in 1962 by Montreal Engineering Co. Ltd. Their study identified twin Gorges as the most attractive site.

Twin Gorges Generating Station was constructed during the period 1963 – 1965 essentially in accordance to the scheme outlined in Montreal Engineering's study.

## 1.1 Description of Facilities

### 1.1.1 Geographical Setting

The Taltson hydro plant is located on the Taltson River some 36 km northeast of Fort Smith at approximately 60" 25'N latitude and 110" 24'W longitude. The Nonacho Lake storage dam is located 215 km northeast of Fort Smith at 61" 40'N latitude and 109' 56'W longitude **(see Figure: 1)**.

### 1.1.2 Dam Description and Classification

**Description of Taltson G.S.**

Taltson River Basin

The Taltson River flows in an irregular pattern in its upper reaches and then northward in its lower reaches finally emptying into Great Slave Lake about 55 km east of Fort Resolution. It has a drainage area of about 65,000 km2 bounded by Slave River, Lake Athabasca, the headwaters of the Dubawnt River, (**see Figure 2**).
The drainage basin is almost entirely within the Canadian Shield region, with bedrock being mainly Pre-Cambrian. The basin is characterized by thinly spread glacial and post glacial drift. The Taltson River channel is controlled by geological and post glacial features, for the most part, except for the lower 115km where it is confined to the eastern margin of the Slave River delta.
From its headwaters, the main stem of the Taltson River is about 650 km long and links a series of interconnected lakes. Some of the larger ones being Gray, Hjalmar**,** Tronka Chua, Nonacho, Taltson, King, Lady Grey, Benna Thy, Tsu and Deskenatlata. The Tazin River meets the Taltson River some 75 km below the outlet of Hill Island Lake**.** The Thoa River flows into the Tazin River at Hill Island Lake. The other principal tributary of the Taltson is the Tethul River which drains the southwestern corner of the basin including the northeastern corner of Alberta.
Between Nonacho Lake at elevation 320.0 m and Great Slave Lake at elevation 157.0 m, the short inter lake stretches of Taltson River are featured by numerous rapids and falls.

Since there is relatively little overburden, river sediment load is light and what little material is moved settles out in the many lakes along its course.

Annual precipitation in the basin area is approximately 280 mm. Particulars on the main tributaries are summarized in Table 1-1

| Sub Basin | Drainage Area (km2) | Cumulative Drainage Area (km2) | |
|---|---|---|---|
| Taltson (above porter lake) | 12,800 | 12,800 | |
| Porter Lake | 2,060 | 14,860 | |
| Nonacho lake | 7,740 | 22,600 | |
| Thoa | 9,630 | | |
| Tazin | 6,270 | 38,500 | |
| Taltson (local inflow) | 8,000 | 46,500 | Twin Gorges Area |
| Taltson (local inflow) | 3,200 | 49,700 | Taltson at Tsu Lake |
| Taltson (below Tsu Lake) | 6,300 | 56,000 | Drainage at mouth |

In 1939, Eldorado Nuclear Limited constructed a dam at the outlet of Tazin Lake to divert flow of the upper Tazin River into the Charlot River (part of the Athabasca basin) where Eldorado Nuclear (now SaskPower) operates three run-of-river generating stations. Diversion from Tazin Lake into Charlot River was by mean**s** of a tunnel. In 1959, this dam was raised a further 2.0 m to increase the live storage for flow regulation on Charlot River. A**s** a result of this diversion only peak summer flows continue to be spilled into the Tazin-Taltson system - which corresponds to about 5% of the natural flow at this point.

**Main Dam and Powerhouse**

Twin Gorges dam is a 285 m long, maximum 25 m high zoned earth and rock fill dam with a filtered central till core. A reinforced concrete intake structure located on the upstream face of the main dam is equipped with trashracks, sectional bulkheads (stoplogs) and a fixed-wheel closure gate. The powerhouse contains a single vertical shaft Francis-type turbine-generator unit with a rated capacity of approximately 18 MW. A 4.9 m diameter, 375 m long buried steel penstock connects the intake to the powerhouse and is fitted with a 12.2 m diameter steel surge tank. The North Valley dam is located approximately 3 km north of the Twin Gorges dam. It is a rockfill freeboard dam with no impervious core, with a rock toe berm constructed on the downstream side equal to the maximum estimated flood level.

Twin Gorges G.S.

The Twin Gorges power plant is located about mid-way between the Tazin-Taltson confluence and Tsu Lake. It was completed in late 1965 following a two year construction period. The site is characterized by two narrow gorges. The plant is located in the north gorge where a 17 m high earthfill dam permits development of a head of 30 m. The south gorge is closed off by an auxiliary dam. A low perimeter dam closes a gap in the reservoir rim in the North Valley **(see Figure 3).**

The powerhouse is founded on bedrock in the north gorge and is connected by a 335 m long, 5 m diameter welded steel penstock to a conventional concrete intake structure. The intake houses a 4.9 m x 4.9 m head gate, cable hoisting equipment and water level gauges. This gate closes by gravity under the control of a fan break. A set of stoplogs are also provided so that the intake may be dewatered to permit inspection and maintenance of the head gate. A mono-rail hoist is provided for handling of the stoplogs and trashracks, as required. A 12 m diameter steel surge tank about 20 m upstream of the plant serves to protect the pipeline from damage due to the waterhammer in the event of a sudden loss of load or from severe load changes. The main plant building has a concrete substructure with a structural steel superstructure. In1976, an additional steel framed annex building was conducted on the downstream side of the original main plant to house four small horizontal-axis Ossberger turbines. Water supply was provided by means of an auxiliary penstock 2.1 m in diameter branched off the main steel penstock 30 m above the surge tank and routed around the south side of the main plant. The Ossberger units discharged directly into the tailrace of the main plant. In 1995 the Ossbergers were decommissioned and are scheduled to be removed in 2014.

The nominal capacity of Twin Gorges G.S. is 18 MW. The plant is controlled by SCADA from the Control Centre in Yellowknife.

South Valley Spillway

Any flows in the Taltson River not passing through the plant for power production are spilled over a 200 m long overflow concrete spillway constructed in a natural spill section called "South Valley", some 13 km northeast of the plant. The spill water re-enters the Taltson River via a 30 km long reach of Trudel Creek at a point 2 km below the Twin Gorges plant **(see Figure 3 ).**

Nonacho Lake Storage Dam

Early in 1968, a rockfill dam was constructed at the outlet of Nonacho Lake to create upstream storage to supplement natural winter flows in order to meet increased power demands on the system. The dam contains three manually-controlled gates (1.8 m **x** 1.8 m) which are periodically opened and closed as natural flows dictate. A natural rock escarpment adjacent to the dam has been widened to 67 m to form an overflow spill **(see Figure 4 and 5).** A fraction of the spill flow exits from Nonacho Lake through a natural gap (referred to as Tronka Chua gap) into Tronka Chua Lake, and eventually re-enters the Taltson River above the Twin Gorges. In addition, approximately 6.5 m3/s percolates through the dam. A live storage volume of 1030 million m2 is provided between a full supply level (FSL) of 320.0m and a low supply level (LSL) of 318.2m.

Transmission Lines

Energy is transmitted to Fort Smth and the Pine Point Substation by means of a 115 kV transmission line carried on guyed ***'Y'*** aluminum towers. Fort Resolution is also supplied via a 35 kV intertie from Pine Point substation. Hay River and Enterprise are supplied via a 72 kV transmission line that is owned and operated by Northland Utilities Limited.. The Buffalo River Highway Maintenance Camp is supplied by NTPC from Pine Point via a 7.2 kV line underslung on NUL poles. The link between Pine Point and Hay River was completed in 1987

/ 88. Mine operations at Pine Point ceased in 1992 following several years of decline and the community of Pine Point has been abandoned.

Fort Smith Diesel Plant

NTPC operates a diesel generating plant in Fort Smith. It functions primarily as a standby power source. There are three diesel sets presently in service, having a total capacity of 6 MW. There is one double walled storage tank adjacent to the plant with a total capacity of 90,000. The Fort Smith plant also houses administrative offices and the local servicing centre.

**Dam Classification**

The Guidelines recommend structures be classified based on the reasonably foreseeable incremental consequences of failure of the dam. The classification system does not consider the potential for failure or probability of failure of the dam structure itself. In other words, the classification is not influenced by the structural integrity of the dam. Potential incremental consequences are evaluated in terms of:

- Life Safety
- Infrastructure and Economic Impacts
- Environmental and Cultural Impacts

The Guidelines recommend evaluation of potential losses from a dam failure is based on inundation studies. These studies typically model flood flows with and without a dam failure to determine a baseline condition and a flood condition. The incremental consequences are those that are incurred between the two flood levels. Inundation studies also typically consider a “Fair Weather Failure” scenario whereby dam failure is modelled during normal operating conditions. In this instance, the incremental consequences are equal to the total consequences. For projects located in largely uninhabited areas this requirement may be omitted since a visual assessment of the area is usually sufficient to identify population or facilities at risk. The Guidelines classification system for dams is outlined in Table 3.1

Dams at the Taltson were previously classified using the 1999 Dam Safety Guidelines of the CDA and the Downstream Classification Guide of the BC Dam Safety Regulations. The rationale is the downstream is largely unpopulated and rigorous inundation mapping required for High consequence dam in the 1999 guidelines is unnecessary. The 2007 edition of CDA’s Sam Safety Guidelines introduced an additional category “**Significant** that is intermediate between “**Low**” and “**High**” risk categories. Meco believes the significant category adequately addresses most consequences previously classified as high for Taltson**.**

Table 3.1 **CDA Classification System (2007)**

| | | Incremental Losses | | |
|---|---|---|---|---|
| Dam Classification | Population at Risk | Loss of Life | Environmental and Cultural Values | Infrastructure and Economical |
| Low | None | 0 | Minimal short-term loss<br>No long term loss | Low economic losses; aera contains limited infrastructure or services |
| Significant | Temporary Only | Unspecified | No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration or compensation in kind highly possible | Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes |
| High | Permanent | 10 or Fewer | Significant loss or deterioration of important fish or wildlife habitat.<br>Restoration or compensation in kind highly possible | High economic losses affecting;<br>infrastructure, public transportation and commercial facilities |
| Very High | Permanent | 100 or Fewer | Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but not practical | Very high economic losses affecting; important infrastructure or services (e.g. highways, industrial facilities, storage facilities for dangerous substances.) |
| Extreme | Permanent | More than 100 | Major loss of critical fish or wildlife habitat.<br>Restoration or compensation in kind impossible | Extreme losses affecting critical infrastructure or services (e.g. hospital, major industrial complex, major storage facilities for dangerous substances) |

**ClassificatIon of Twin Gorges Dam**

The impact of failure of Twin Gorges dam and the release of the contents of forebay reservoir would be limited to the reach of Taltson River between the generating site/Elsie Falls and Nende Rapids/Tsu Lake, a distance of about thirty (30) kilometre. Some attenuation of the dam break flood peak can be expected within this reach. Also, Tsu Lake, which is much larger than Forebay Reservoir, should further attenuate the flood peak, so that the peak flow below the outlet of Tsu Lake should be within historical flood limits. It is our understanding that within the effected reach there are only a few trapper cabins that are temporarily occupied (mainly in winter) and therefore the risk of loss of human life is judged to be **significant.**

Infrastructure and economic losses would result from the loss of power production from Twin Gorges generating station. However, the availability of back-up diesel capacity to fully replace loss of hydro production from the plant mitigates the severity of this loss. The cost of restoring the dam and the generation station will be substantial and for that reason we recommend a **significant** classification based on potential economic losses.

Finally the environmental damages due to a dam break flood would harm fish habitat, denude terrain and silt lakes in the reach. The impacts are likely to be temporary, of limited extent and natural recovery should occur quickly. It is our judgement that the environment and cultural consequences of a dam failure are **low.**

In summary:

• Based on loss of life unspecified nil/low the rating is Significant
• Based on economic losses the rating is Significant
• Based on potential environmental losses is Low

The Twin Gorges dam does not have a dam failure model and the associated inundation maps. The recommended classification is based on a qualitative assessment of consequences of a dam failure. For the remote site. a qualitative assessment of consequences is adequate. Overall, the recommended consequence classification for Twin Gorges dam is **Significant**, as a result of Loss of Life Criteria and Economic and Infrastructure criteria.

The recommended Inflow Design Flood (IDF) is a flood event with a peak magnitude of between 100 years and 1000 years. Because the consequences would tend to the higher end of the significant category, an IDF with an AEP peak magnitude of 1,000 years is recommended for the Twin Gorges dam. The recommended Earthquake Design Ground Motion (EDGM) is an event with an Annual Exceedance Probability (AEP) of 1,000 years.

**Classification of North Valley Dam**

The North Valley (Freeboard) dam is a relatively low dam that is not retaining water for much of the year. Loss of life is not anticipated from a failure and the economic and infrastructure consequences are restricted to partial loss of the reservoir. The environmental and cultural losses would likewise be temporary.

The North Valley dam does not have a dam failure model and the associated inundation maps. The recommended classification is based on a qualitative assessment of consequences of a dam failure. For such a low head structure in a remote location, a qualitative assessment of consequences is adequate. Overall, the recommended consequence classification for North Valley dam is **Low**.

The recommended Inflow Design Flood (IDF) is a flood event with a peak magnitude of 100 years. The recommended Earthquake Design Ground Motion (EDGM) is an event with an Annual Exceedance Probability (AEP) of 500 years.

**Classification of South Valley Spillway**

The South Valley spillway is a relatively low head weir that overtops continuously. Loss of life is not anticipated from a failure and the economic and infrastructure consequences are restricted to partial loss of the reservoir. Possible environmental damages along Trudel Creek could be more severe but still within the significant class. Economic losses could be somewhat less as repairs could be done more rapidly.

Similar to Twin Gorges dam and North alley dam, the South Valley Spillway does not have a dam failure model and the associated inundation maps Likewise, for such a low head structure m a remote location, a qualitative assessment of consequences is adequate. Overall, the recommended consequence classification for South Valley spillway is **Significant**.

As noted at Twin Gorges dam, the recommended IDF for Significant consequence classification dams is a flood event with a peak magnitude of between 100 years and 1,000 years. As noted the Twin Gorges dam requires a spillway with an IDF of 1,000 years and, therefore, South Valley Spillway is required to have an IDF with an AEP peak magnitude of 1,000 years. The recommended Earthquake Design Ground Motion (EDGM) is an event with an Annual Exceedance Probability (AEP) of 1,000 years.

**Classification of Nonacho Dam**

In terms of loss of life criteria, the reach downstream of Nonacho Dam contains a few hunting / fishing lodges and trappers cabins, which are considered temporary. A dam failure would result in an uncontrolled release of a large volume of water but the rate would be controlled by the low height of the dam relative to water depth and a non-erodible dam foundation in rock. A rough calculation estimated the peak outflow between 600 m3/s to 1,380 m3/s. The latter value plus intermediate inflow about equals the capacity of South Valley Spiliway.

As such, there is little opportunity for cascade type failure during a fair weather event, although a failure during the IDF could impact Twin Gorges dam. The possibility that Twin Gorges Dam would be overtopped is considered unlikely but cannot be definitively discounted without detailed dam break analysis. The environmental and cultural losses would likely be temporary.

The Nonacho dam does not have a dam failure model and the associated inundation maps. The recommended classification is based on a qualitative assessment of consequences of a dam failure which, for the remote site, is adequate. Overall, the recommended classification for Nonacho darn is **Significant**, for the same reason that Twin Gorges; loss of life criteria and infrastructure and economic consequences. The recommended IDF is the I in 1000 year flood. The recommended Earthquake Design Ground Motion (EDGM) is an event with an Annual Exceedance Probability (AEP) of 1,000 year.

### 1.1.3 Spillway Description and Capabilities

**Taltson Dam Spillway**

The South Valley Spillway is located approximately 10 km northeast of the generating station and consists of two reinforced concrete ogee-type free-overflow sections with a crest level at El. 239.30 m (785.0 ft) local datum and a third small natural channel. The spillway discharges excess inflow into Trudel Creek which joins the Taltson River immediately downstream of Elsie Falls, approximately 1.8 km downstream of the Twin Gorges dam.

**Nanocho Spillway**

The general arrangement of the Nonacho Lake Control structure is shown on Figure 4 and 5. The control structure was constructed in 1968 at the outlet of Nonacho Lake to increase the firm winter flow. The structure raised the level of the lake by approximately 2.6 m and the total volume of water impounded by the structure at a lake level of El. 321.1 m is approximately 3.3 million cubic meters. The control structure consists of: a 160 m long, maximum 9 m high rock fill dam; a control structure comprising three wooden box culvert sluices each with a vertical, wooden slide gate manually controlled with a screw hoist operated by a portable electrically-powered drill-type actuator; and a free-flow rock-cut spillway channel approximately 68 m wide situated adjacent to the right abutment of the dam.

## 1.2 Operational Responsibilities

### 1.2.1 Reporting Structure

The Taltson Operator stationed at the Twin Gorges G.S. reports to the Operations & Maintenance Manager, South Slave in Ft. Smith who in turn reports to the Hydro Region Director in Yellowknife. For technical assistance, there is the System Control, Manager in Yellowknife and Engineering Director based in Hay River.

### 1.2.2 Duties and Qualifications of Operators

TWIN GORGES TALTSON

Operations Procedure

A. HEADGATE.

1. Check fore bay level, log reading, report reading to YK Control.
2. Check heaters are operational in winter, check for ice buildup in penstock vents in winter.
3. Check for ice buildup in fore bay level wells in winter. Check heating light bulbs in winter replace as required.
4. Clear snow from access pathways in winter.
5. Check for free movement of venting louvers.
6. Check all lighting.

B. SUBSTATION.

1. Check Transformer temperatures and log readings.
2. Take note of oil levels in transformers.
3. Take note of oil levels in bushings
4. Take note of gas level indicators.
5. Take note of Silica Gel colours, (Bright Orange, Deep Blue O.K.)
6. Check all lighting.
7. Check for leaks on all transformers, Report all leaks to Ft. Smith Office and fill out Spillage Report.
8. Take note of ice conditions on rock face in winter.
9. Clear snow from pathways and steps to ASEA Transformer in winter.

C. PLANT.

1. Check Excitation Volts and Amps. Log readings (from Control Panel).
2. Check and Log readings for Megawatts, Megawars, AC Volts, AC Amps, Station Service Kwh, Station Service Demand, Generator Kwh, Generator Demand (from computer).
3. Check Generator Stator temperatures and log readings.
4. Check and log readings for Headcover, Penstock and Draft Tube pressures.
5. Check Generator Slip Rings ie; free movement of carbon brushes, temperatures of carbon brushes.

6. Check and record Plant temperature.
**7.** Check Oil level on Generator Guide Bearing (add oil as required).
8**.** Check and record which Governor Oil filter is in operation, note differential pressure indicator, change filter as required.
9**.** Inspect all around inside Governor Cabinet for any mechanical abnormalities or oil teaks. (Report either of the above to Ft. Smith 24hrsl day, 7 days/ week.
10. Check operation of Governor Oil Pressurizing Pump, rotate operational pump weekly, ie; Lag *I* Lead.
11. Check and log Governor oil pressure.
12. Check Governor oil level in Sump Tank, (add oil as required).
13. Check Air / Oil ratio in Governor Accumulator, Add air as required.
14. Check Battery Charger for correct operation, Log Amps and Voltage readings. Note any Ground Fault indications.
15. Check Inverter for correct operation, Log Amps and Voltage readings.
16. Visual inspection of Station transformer. Log temperature reading and check for leaks. Report any leaks to Ft. Smith.
17. Check Greasing System, Log readings from Counters for Primary and Secondary systems. Check quantity of grease in barrels, replace barrels as necessary. Check discs at Distribution Blocks. (AT SHIFT CHANGE ONLY).
18. Check and log reading for Generator Guide Bearing temperature,
    Check and log reading for Turbine Guide Rearing temperature,
    Check and log reading for Turbine Thrust Bearing temperature,
    Check and log reading for Water Flow through Generator Bearing.
    Check and note Water Flow through Main Carbon Seal.
19. Check Compressors for correct operation. Check Oil levels in compressors, ( Add Oil as required).
    Check for Air leaks on associated pipework.
    Blow down any Condensate from all three Air Receivers.
    Check Drive Belt Tension on both Compressors (Deflection on the belts and Checking Procedure in separate instructions).
    Check Drive Belt Guards are firmly in position.
    Rotate operational compressors weekly ie; Lag / Lead.
20. Check Oil I Water Separator is functioning correctly.
    Note Fluid level in Sludge Tank, drain as necessary.
21. Check and log temperature in Ossberger Room.
22. Check and adjust louvres in Windtunnel to suit Generator Winding temperature.
    Clean screens of insects and other debris in the summer.
    Clean external screens of insects in summer and snow *1* frost in winter.
    Clear snow off walkway in winter.
    Note water flow from Utilidor drain.
23**.** Check Tailrace level, Log reading.
24. Check Turbine Guide Bearing Oil Level (AT SHIFT CHANGE ONLY ).
    Inspect Turbine Pit for oil and water leaks, inspect Grease Distribution Blocks for blown discs
25. Motor Control Centre, Check all fevers for tripped Breakers,
    Check all indicator light bulbs at individual controls, replace bulbs as necessary.
26. Check Alarm Annunciator Board with TEST button, Replace any blown indicator bulbs.
27. Check Temperature Indicator on Exciter Panel " Mezzanine Floor"
    DO NOT OPEN DOORS IF MAIN GENERATOR IS RUNNING.

28. Standby Diesel Room.
 Check Unit for oil and water leaks, {report any leaks to Ft, Smith)
 Check Battery Levels (weekly) FACE SHIELD AND RUBBER GLOVES MUST BE USED.
 Run Standby Unit MONTHLY (Follow Separate Operating Instructions).

D. EXTERNAL AREAS.

1. Check all external lighting; report any anomalies to Ft. Smith.
2. Check Standby Diesel Fuel Tank, maintain fuel level in tank between 75% and 80% Full. Check associated pipework for leaks, if any leaks are noted, rectify leaks if possible. Notify Ft. Smith and fill out Spillage Report if necessary.
 Change Racor Filters on a Daily basis when the Standby Unit is operational
3.Check Surge Tank heaters for operation in winter by viewing indicator lights at base of tower.
4.Check operation of Camp Water Supply System, rotate and clean Duplex Fitters (when installed). Check heating system in shack.
5. Check heating system at C'tilidor Shack and clear snow from steps in winter.
6.Check heating inside Communication Shack and clear snow from steps and walkway in winter.
7.Clear snow from steps between Lower Roadway and Houses in winter.

E. HOUSES and GARAGE.

1.Check beneath both Houses for heating in winter.
 Check beneath both Houses for leaking pipes etc.
 Check beneath both Houses for any signs of VERMIN if any indication of Vermin is noted, Report to Ft. Smith Immediately.
2. Check heating in Garage in winter. Keep garage Parking and Working Areas clean.
3. Keep pathways around Garage and Houses free of snow in winter.
4. When NTPC Maintenance Crew or Contractors are in for work at Taltson, prepare Meals, Keep Kitchen and Dining Areas clean. Make beds in Transient Quarters daily. Keep ALL rooms in Transient Quarters clean. Every third day Launder all used bedding. Towels Etc. should he laundered as necessary.
5. Remove Garbage to the Dump Daily and incinerate as required.
6. Keep all Roadways clear of snow in winter, "With the Exception of the Roadway between the Houses and the Tailrace". THIS SECTION OF ROAD IS CLOSED IN WINTER.
7. Keep Airstrip ploughed free of snow in winter. Keep aircraft Parking Area free of snow in winter. Clear snow away from Airstrip Reflectors. Test Strobe Lights at each End of Airstrip on a Weekly basis. 1,og testing in plant Logbook.
8. Test Communications between Taltson and Ft. Smith TWICE daily, in the morning by Telephone and the afternoon by Radio. Test MANDOWN Alarm Radio between Taltson and YK Control on a weekly basis. Test SATELLITE Telephone on a weekly basis.

## 1.3 Permanent Record File

### 1.3.1 Location

The permanent record file will be located in the office of the System Control, Manager in Yellowknife, and on the electronic filing system (Imanage)

### 1.3.2 Contents

At the end of each year, the log book from each plant shall be reviewed for any reference to the dam or spillways and the appropriate pages copied and kept in the permanent record file.

# 2 Operation

## 2.1 Inflow Design Flood ( IDF )

Based on the 1 / 1000 annual ascendance (AEP), the Inflow design flood (IDF) for Taltson is between 850 and 900 m3/s. Based on the 1 / 1000 annual ascendance (AEP), the Inflow design flood (IDF) for Nonacho Lake is 450 m3/s.

## 2.2 Allowable Reservoir Levels

The following are the allowable Reservoir Levels:

| **Plant Name** | **Minimum (m/ft)** | **Normal Maximum (m/ft)** | **High Flow Maximum (m/ft)** |
|---|---|---|---|
| Taltson | 238.9 / 783.8 | 239.27 / 785.04 | 240.9 / 790.39 |
| Nonacho | 319.3 / 1047.6 | 320.0 / 1050.0 | 321.9 / 1058.12 |
| | | | |
| | | | |

## 2.3 Allowable Water Flows

| **Plant Name** | **Maximum (m3/s / cfs)** | **Minimum (m3/s / cfs)** |
|---|---|---|
| Taltson | 900 / 31783 | 28.0 / 988.8 |
| Nonacho | 450 / 15891 | 14.0 / 494.4 |
| | | |
| | | |

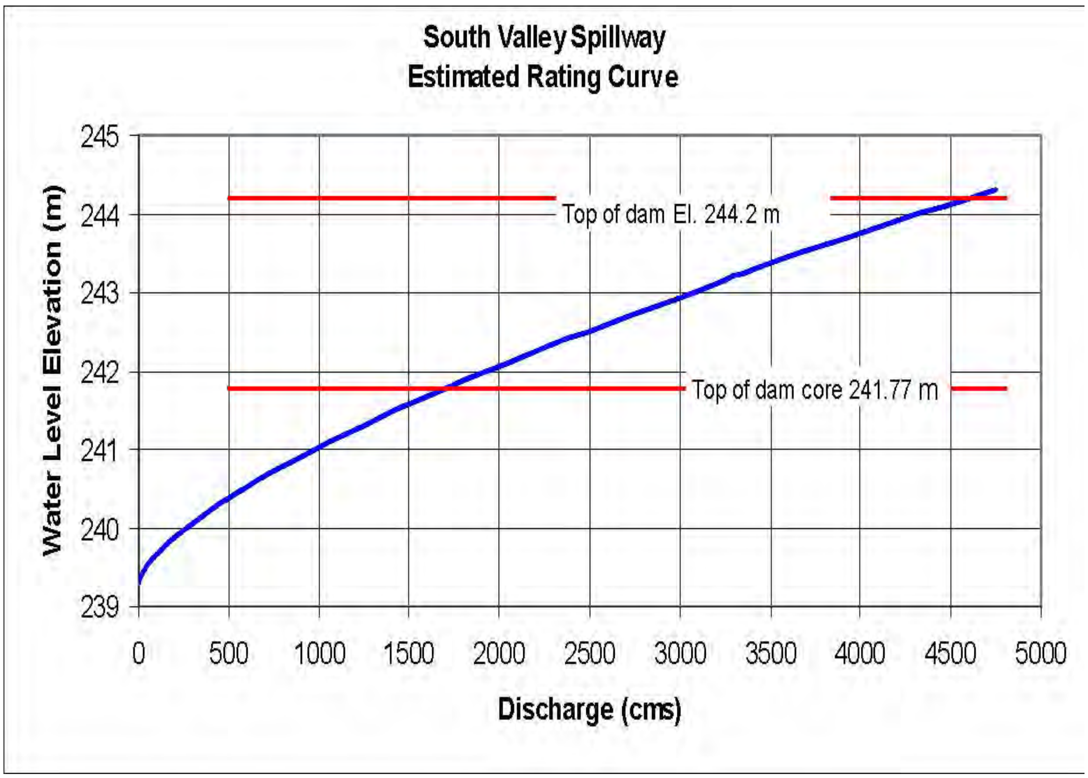
## 2.4 Spillway Design Capacities

### 2.4.1 Operating Parameters

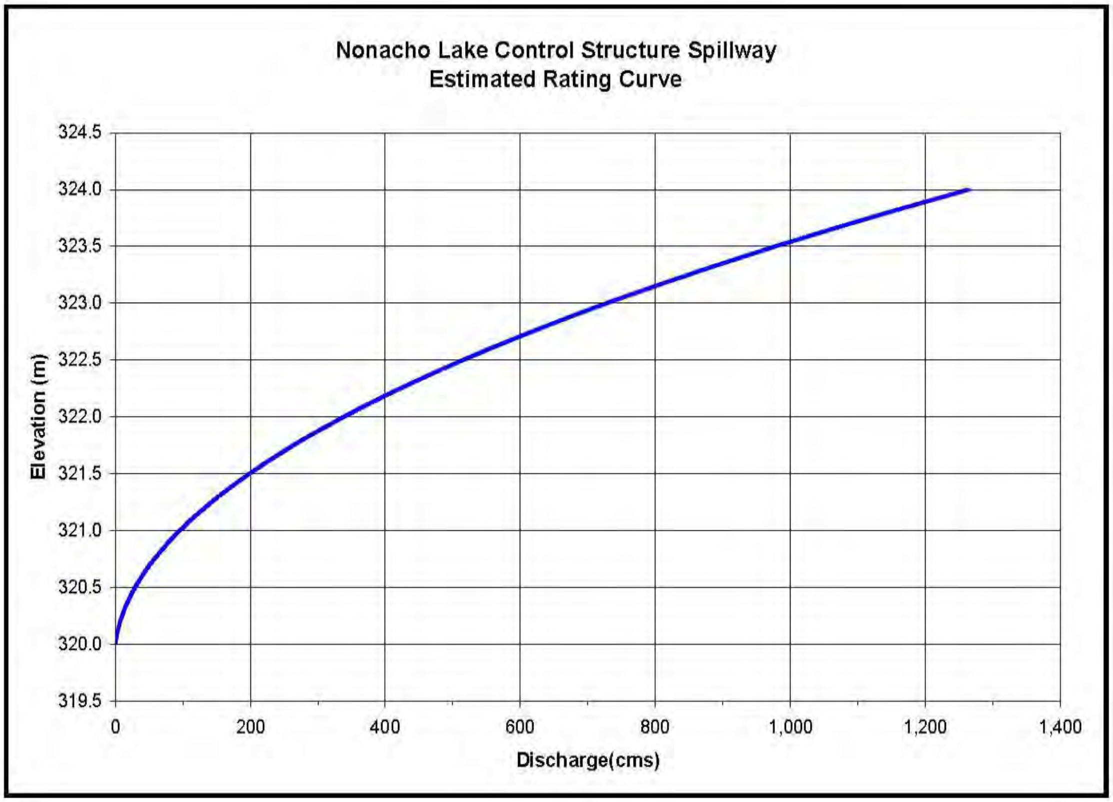
The South Valley spillway is a fixed overflow type that will start spilling at elevation 239.3 m (785.0 ft)
The Nonacho Lake spillway has a fixed overflow at elevation 321.1 m (1053.5 ft) and three wooden box culvert sluices each with a vertical wooden slide gate, manually controlled with a screw hoist. The gates are to allow minimum flow if Nonacho Lake is below elevation 321.1 m

### 2.4.2 Rating Curves

Taltson Spillway



Nanocho Spillway

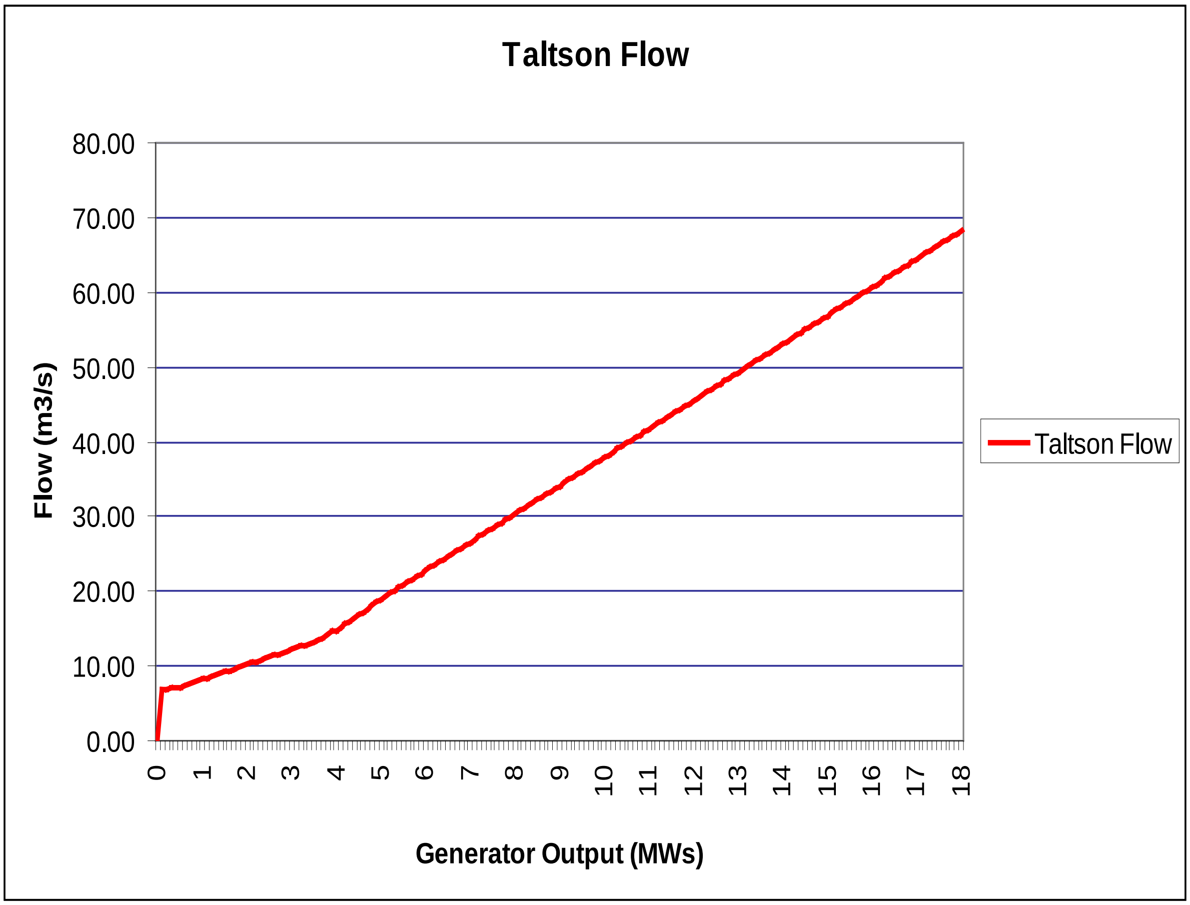


## 2.5 Turbine Design Capacities

### 2.5.1 Operating Parameters

The Taltson facility is the only hydro unit operating on the South Slave system and is operated to match the required load.

### 2.5.2 Rating Curves



## 2.6 Operational Philosophy

In 1968, a storage dam and control structure was constructed at the outlet of Nonacho Lake to provide about 1030 X 10  6 m3 of storage between a low supply level of 318.2 m and a full supply level of 320.0 m. The purpose of this storage reservoir was to regulate flow at Twin Gorges Power Plant so as to increase the firm energy output from that plant and to enhance its ability to meet the energy demands of the system. Flow regulation is achieved by storing a portion of the spring flow and releasing the stored water later during low flow periods to augment the natural flow. This storage dam consists of a rock fill dam, a control structure – comprising of three 1.8 m x 1.8 m water passage controlled by upstream gates and an overflow spillway excavated in a rock barrier adjacent to the dam having a width of 67 m and at crest elevation of about 320.0 m. water also escapes via another naturally occurring low point in the reservoir rim known as the Tronka Chua Gap, when the water level exceeds 320.3 m. some water is also released via percolation through the dam.

During the times when Pine Point Mine was in operation and the system load was large, Nonacho Lake Reservoir was operated to meet power generation demands and also to respect the operating requirements of the water licence: that is, to maintain Nonacho Lake levels within range 319.5 m  to 321.9 m and to assure minimum flows of at least 14 m3/s below Nonacho and 28 m3/s below Twin Gorges.

Since the closure of Pine Point Mines the system loads are much reduced and the natural low flows suffice to meet the energy demands of the system (until the system load growth approaches historic maximum levels, or new mines are added to the load). Accordingly, under current circumstances, Nonacho Lake Reservoir is not operated to meet power demands.

Current practice is to leave one gate permanently open to attenuate high water levels in Nonacho Lake.

## 2.7 Forecasting

### 2.7.1 Methodology

Currently there is no forecasting done for the operation of the Taltson G.S. as the loads are not sufficient to warrant the operation of gates at Nonacho Lake or the manipulating of loads at the Taltson G.S. With minimum flow the Taltson G.S. can operate to meet the required load and the reservoir continues to maintain an elevation above the spillway elevation.

### 2.7.2 Data Sources

Two real time Environment Canada WaterWeb sites are available on the internet for real time elevations. They are located at ; Nonacho Lake near Lutselk'e ( 07QD002) and Taltson River below Hydro Dam (07QD007).

The Taltson Snow Survey is done with assistance from the Meteorological Service of Canada, Climate Processes and Earth Observation Division, from January to May satellite shots are sent to NTPC indicating the water equivalency in the snow pack. Every year manual readings are taken at ten different locations, in April by INAC to verify the satellite readings:

**AANDC Spring Snow Surveys - Northwest Territories**

**Snow Water Equivalent - 2013**

| | Long | Lat | Elevation | Years of Record | **Mean** SWE (mm) | **April 2013 surveys** SWE (mm) | Depth (cm) | **% normal** SWE 2009 |
|---|---|---|---|---|---|---|---|---|
| **Taltson River Basin** | | | | | | | | |
| Piers Lake | -111.17 | 60.32 | 260 | 30 | 105.0 | 71.1 | 51.0 | 67.7 |
| Tortuous Lake | -111.70 | 60.75 | 230 | 44 | 85.3 | 55.9 | 41.8 | 65.5 |
| Dunvegan Lake | -107.28 | 62.33 | 490 | 46 | 112.6 | 95.3 | 57.8 | 84.6 |
| Whirlwind Lake | -108.68 | 60.25 | 430 | 44 | 97.2 | 66.0 | 51.0 | 68.0 |
| Alcantara Lake | -108.28 | 60.90 | 425 | 44 | 102.1 | 78.7 | 58.2 | 77.1 |
| Hill Island Lake | -109.90 | 60.50 | 330 | 46 | 95.8 | 76.2 | 52.8 | 79.6 |
| Thekulthili Lake | -110.23 | 60.97 | 320 | 44 | 88.4 | 63.5 | 50.2 | 71.8 |
| Nonacho Lake | -109.67 | 61.72 | 320 | 46 | 106.1 | 54.6 | 47.9 | 51.5 |
| Halliday Lake | -109.03 | 61.38 | 350 | 46 | 101.5 | 68.6 | 54.9 | 67.6 |
| Gray Lake | -108.30 | 61.80 | 320 | 47 | 107.4 | 78.7 | 46.6 | 73.3 |
| Dymond Lake | -106.28 | 61.38 | 395 | 45 | 117.6 | 92.7 | 52.6 | 78.8 |
| | | | | | **101.7** | **72.9** | **51.3** | **71%** |

### 2.7.3 Water Balance

Pre Spilling

The South Valley spillway is a fixed spillway at an elevation of 239.3 m (785.0 ft). Spilling can not take place until the reservoir has reached an elevation of 239.3 m.

Flood Routing

When the reservoir elevation excides an elevation of 239.3 m the excess water is discharged over the South Valley spillway.

## 2.8 Normal Operating Procedures

The Taltson G.S  is operated to match the required load.
Reservior elevation of 239.6 m, South Valley spillway spilling 111 m3/s.

## 2.9 Flood Operating Procedures

The three gates at the Nonacho Lake spillway will be opened.
In the 1 / 1000 year occurrence reservoir elevation would be 240.9 m; the South Valley spillway would be spilling 900 m3/s.

## 2.10 Emergency Operating Procedures

The top of the dam core is at 241.77m to reach this the inflows would have to be 1650 m3/s well above the 1 / 1000 year occurrence and the top of the dam is at 244.2 m. To over top the dam the flows would have to be 4500 m3/s.

## 2.11 Ice and Debris Handling

The Taltson G.S. is the only plant operating on the South Slave system, thus it is in operation all winter and ice does not have a chance to build up. If the plant has to come off line for any reason during the winter there are agitators at Taltson that can be placed at the headgate and tailrace to keep open water.
Debris is picked up by use of a gaff located at each head gate deck. The trash racks are cleaned by divers annually.

## 2.12 Review Procedures

Procedures will be reviewed once a year by the System Control Manager and the Hydro Maintenance Manager. If any changes are to be made, they will be done at this time.

# 3 Maintenance

## 3.1 Maintenance Responsibilities

The Hydro Maintenance Manager is responsible for the Dam, Spillway, Turbine and other Structures and Equipment maintenance. The Hydro Maintenance Manager reports to the Hydro Operations Director. The Maintenance on these facilities is done by the Plant Operator, Electricians, Mechanics, Millwright and contractors depending on the work to be done.

## 3.2 Maintenance Programs

### 3.2.1 Dams

The Dam Faces, Crest, Toe and Abutments are cleared of excessive vegetation every year. After the Annual Inspection any concerns, such as cracking, settlement erosion, sinkholes or wet spots, will be addressed as soon as possible. Debris is cleared from the Dam and intake area once a year by divers. A survey of the Dam is done every 5 years to determine if there is settlement, erosion or instability anywhere on the Dam.

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **A. POWER DAM, TAILRACE** | | **NOTES** |
|---|---|---|
| | | Required for Dam Safety |
| CONCRETE & MASONRY | ( ) | |
| EMBANKMENTS | ( ) | |
| RIPRAP | ( ) | |
| ROADS WAYS & WALKS | ( ) | |
| RAILINGS & MISC. METAL WORKS | ( ) | |
| STAIRWAYS & LADDERS | ( ) | |
| TRASH RACKS | ( ) | |
| INTAKE STRUCTURE | ( ) | |
| INTAKE HOUSE | ( ) | |
| LIGHTING & POWER | ( ) | |
| INTAKE LIFTING EQUIPMENT ( GENERAL ) | ( ) | |
| FOREBAY | ( ) | |
| HOIST | ( ) | |
| **INSPECTED BY** | | |
| **DATE** | | |

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **C. PENSTOCKS, GATES** | | **NOTES** |
|---|---|---|
| | | Required for Dam Safety |
| PENSTOCKS | | |
| TUNNEL | ( ) | |
| TUNNEL / LINER CONNECTION | ( ) | |
| | ( ) | |
| GATE | ( ) | |
| SEALS & GUIDES | ( ) | |
| WHEELS, PINS & ROLLERS | ( ) | |
| STEEL STRUCTURE | ( ) | |
| PAINT PROTECTION | ( ) | |
| CLEANLINESS | ( ) | |
| GATE HOIST ( SEE D ) | ( ) | |
| ELECTRIC MOTOR ( SEE G ) | ( ) | |
| ELECTRIC CONTROL ( SEE M ) | ( ) | |
| GATE HOUSE | ( ) | |
| FIRE PROTECTION | ( ) | |

**INSPECTED BY**

**DATE**

### 3.2.2 Spillways

South Valley Spillway

Inspect concrete when water levels permit.

Nanocho Lake Spillway

Inspect dam annually.
Inspect gates annually.
Operate gates annually.

### 3.2.3 Turbines

Taltson

Once a year clearance measurements are taken of the turbine and wicket gates. The turbine and gates are also inspected for cracks or pitting. The walls of the scroll case are also inspected for erosion.

# TALTSON

## PLANT MAINTENANCE AND OPERATION INSPECTION & MAINTENANCE CHECK LIST

| **F. HYDRAULIC TURBINES & GOVERNORS** | | **NOTES** |
|---|---|---|
| | | Required for Dam Safety |
| TURBINES | | |
| RUNNER | ( ) | |
| STEAL RINGS | ( ) | |
| SCROLL CASE | ( ) | |
| WICKET GATES | ( ) | |
| WEARING RING | ( ) | |
| GATE LINKAGE | ( ) | |
| DRAFT TUBE | ( ) | |
| SHAFT & COUPLING | ( ) | |
| BEARINGS , OIL SAMPLE | ( ) | |
| SERVOMOTOR CYLINDER, PISTON & ROD | ( ) | |
| MAIN SEAL | ( ) | |
| LUBRICATION ( SEE E ) | ( ) | |
| THERMOMETERS, GAUGES | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| F. HYDRAULIC TURBINES & GOVERNORS | | NOTES |
|---|---|---|
| | | Required for Dam Safety |
| GOVERNORS | | |
| ELECTRIC CONTROL DEVICES ( SEE M ) | ( ) | |
| BEARINGS & MOTORS | ( ) | |
| SPEEDER ROD & VIBRATOR | ( ) | |
| PILOT, RELAY VALVES | ( ) | |
| STRAINERS | ( ) | |
| COMPENSATING DASHPOT ASSEMBLY | ( ) | |
| OIL PIPING & PRESSURE TANK | ( ) | |
| PMG ASSEMBLY | ( ) | |
| CONTROLS & INDICATORS | ( ) | |
| LINKAGE & PINS | ( ) | |
| OIL PUMPS | ( ) | |
| OIL SAMPLE | ( ) | |
| SAFETY VALVES | ( ) | |
| REGULATING VALVES | ( ) | |

**INSPECTED BY**

**DATE**

# Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Air Brakes Control Valve | Weekly: Inspect the air supply pressure gauge inside of the HPU. Tolerance: Gauge reads air supply system pressure = acceptable; Gauge reading does not match air supply system pressure = problem. | | Not applicable. | Overhaul by valve manufacturer only. |
| Desiccant Air Breathers | Weekly: Visually inspect the silica gel desiccant. Tolerance: Blue color = acceptable; Pink color = replace. Verify that air intake ports to breather are not plugged. Tolerance: Not plugged = acceptable; Plugged = problem. | When silica gel color changes from blue to pink, replace the desiccant breather. | Replace desiccant breather after 12 months of continuous in-service. | When silica gel color changes from blue to pink, replace the desiccant breather. |
| Hydraulic Oil | Every 6 months: Perform an oil cleanliness test. Tolerance, based upon ISO 4406 Cleanliness Level: 15/12 = normal; 16/13 = minimum. | Following major repairs that require disassembly of piping: Perform an oil cleanliness test. Tolerance, based upon ISO 4406 Cleanliness Level: 15/12 = normal; 16/13 = minimum. | Not applicable. | |
| Hydraulic Pumps | Weekly: Monitor noise level. Tolerance: less than 90 dB = acceptable; Greater than 90 dB = problem. | Low oil pressure. Tolerance: Flow rate greater than 85% of specified rating = acceptable; Flow rate less than 85% of specified rating = problem. | Not applicable. Overhaul by pump manufacturer only. | Noise level greater than 90 dB or flow rate less than 85% of specified rating. Replace pump. Overhaul by pump manufacturer only. |
| | Every 10 years: Check flow rate. Tolerance: Greater than 85% of specified rating = acceptable; Less than 85% of specified rating = problem. | | | |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Hydraulic Pump Unloaders | Monitor pump unloading time. Tolerance: Short duration of unloading cycle = acceptable; Noticeably long pump unloading cycle = problem. | When clogged filter element signal is received, arrange to have the affected element replaced. | None. | Device failure: Determine and correct cause; repair or replace components as applicable. |
| Hydraulic Servomotors | Every 6 months: Visually inspect servo rod for nicks, scratches or excessive buildup of grime and other debris. Tolerance: No nicks, scratches, or buildup of debris = acceptable; Presence of nicks, scratches or debris buildup = problem. | Gate lock cylinder performance. Tolerance: Smooth engagement and disengagement of locking mechanism = acceptable; Erratic engagement or disengagement of gate lock mechanism = problem. | Follow servomotor manufacturer recommendations. | Servomotor or gate lock cylinder failure: Follow servomotor manufacturer recommendations. |
| L&S-400 Distributing Valve | Every 10 years perform a leakage test per L&S Electric specifications and, if possible, compare the test results to tests performed prior to unit commissioning. Tolerance: Test results comparable to commissioning tests = acceptable; Test results showing considerable deviation from commissioning tests = problem. | If distributing valve malfunctions or performs erratically, troubleshoot and correct cause. | Overhaul per assembly specifications provided by L&S Electric, Inc. only when needed. | If distributing valve malfunctions or performs erratically, troubleshoot and correct cause. |
| LVDT (distributing valve) | None. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| MLDT (gates servomotors) | Weekly: Inspect environment at device location for debris buildup. Tolerance: No debris buildup = acceptable; Noticeable buildup of debris = determine and correct source of contamination. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |
| | During unit shutdowns 6 to 12 months after last inspection, remove the protective cover and inspect for debris buildup under cover. Tolerance: No debris buildup = acceptable; Noticeable buildup of debris = determine and correct source of contamination. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |
| Oil Filter Elements | Weekly: Check visual plugged element indicator. Tolerance: No plugged indication = acceptable; Plugged indication = replace element. | Following major repairs that require disassembly of piping: Tolerance: No plugged indication = acceptable; Plugged indication = replace element. | Replace element(s) after 12 months of continuous in-service. | Upon plugged filter indication, replace element. |
| Pilot Manifold | Refer to oil filter elements information in this chart. | If manifold malfunctions or performs erratically, troubleshoot and correct cause. | Replace the run valve (65-SVR) after 5 years of continuous in-service. | If manifold malfunctions or performs erratically, troubleshoot and correct cause. |
| Speed Sensing Assembly | Unit shutdown. 6 to 12 months after last unit shutdown, remove the PMG cover and inspect the speed sensing components for debris buildup. Tolerance: No debris buildup = acceptable; Noticeable accumulation of debris = determine and correct source of contamination. | Erratic speed signal. Tolerance: Signal is proportional to unit speed = acceptable; Signal is erratic = problem. | None. | If speed signal becomes erratic, inspect the speed sensing circuit as necessary. |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Oil/Nitrogen Accumulators | Weekly: Inspect accumulator system pressure gauge inside of the HPU. Tolerance: Gauge reading within 5 psi of system pressure listed in table on schematic diagram mounted in the HPU door = acceptable; Gauge reading 5 psi greater than or less than value in table = problem. | Accumulator system pressure gauge inside of the HPU begins to flutter suddenly. Tolerance: Steady needle movement within 5 psi of listed system pressure = acceptable; Fluctuating gauge needle = problem. | None. | Upon ruptured nitrogen bladder, overhaul per manufacturer's specifications.. |
| | Every 6 months: Isolate accumulator/gas bottle pairs and check the nitrogen precharge pressure. Tolerance: Pressure reads listed value in schematic diagram inside of HPU door = acceptable; Value reads less than or greater than 5 psi of listed precharge pressure value = problem. | Oil charge time (pump cycle time) becomes unusually short. Tolerance: Charge time duration within normal values = acceptable; Noticeably short time between pump cycles = problem. | | |
| | | Movement of actuators (servomotors) becomes unordinarily slow. Tolerance: Normal actuator stroke speed = acceptable; Noticeably slow actuator stroke speed = problem. | | |
| | | Vibration or noise from oil lines increases abnormally. Tolerance: Oil line vibration or noise within normal levels = acceptable; Noticeably noisy or vibrating oil lines = problem. | | |
| | | Level of hydraulic oil in reservoir ascends or descends abnormally. Tolerance: Steady changes in reservoir oil level = acceptable; Noticeably rapid changes in reservoir oil level = problem. | | |

# WICKET GATE CLEARANCES

**DATE** ____________________ ________________________ Required for Dam Safety

| | | HEEL | TOE | | HEEL | TOE | REMARKS |
|---|---|---|---|---|---|---|---|
| **1** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **3** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **5** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **7** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **9** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **11** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **13** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **15** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **17** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **19** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |
| **20** | TOP | | | TOP | | | |
| | BOTTOM | | | BOTTOM | | | |

### 3.2.4 Other Structures and Equipment

Once a year all head gates are raised to there maintenance positions and pullies, wheels, cables and seals checked. All areas that require it are oiled or greased. Limit switch, heaters, controls and emergency drop are checked. All head gate drop times are recorded. All equipment is cleaned. Any adjustments to limit switch, breaks, etc are undertaken at this time. In October all heaters are checked and the hoist rooms winterized. In winter all deck and walkways are kept clear of snow.

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **B. POWER HOUSE** | | **NOTES** |
|---|---|---|
| DOORS & WINDOWS | ( ) | |
| STAIRWAYS & LADDERS | ( ) | |
| RAILINGS & MISC. METAL WORKS | ( ) | |
| CRANE & HOISTS ( SEE D ) | ( ) | |
| HEATERS | ( ) | |
| VENTILATING FANS | ( ) | |
| WATER SUPPLY & DRAIN PIPE | ( ) | |
| WATER HEATER | ( ) | |
| SINK, TOILET | ( ) | |
| CONDUIT & FITTINGS | ( ) | |
| LIGHTING | ( ) | |
| FIRE PROTECTION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| D. CRANES, HOISTS | | NOTES |
|---|---|---|
| CRANE, RAIL , SUPPORTS & STOPS | ( ) | |
| CRANE BRIDGE & STOPS | ( ) | |
| HOIST FRAMEWORK | ( ) | |
| TRUCK | ( ) | |
| BUMPERS | ( ) | |
| TROLLEY RAILS OR WIRE & SUPPORTS | ( ) | |
| TROLLEY SHOES & SUPPORTS | ( ) | |
| RUNWAYS & CATWALKS | ( ) | |
| LADDERS & HAND RAILS | ( ) | |
| CAB | ( ) | |
| DRIVING GEARS, SHAFTS | ( ) | |
| BEARINGS & WHEELS | ( ) | |
| BRAKES | ( ) | |
| CABLE DRUMS & SHEAVES | ( ) | |
| BLOCKS & HOOKS | ( ) | |
| ELECTRICAL MOTORS ( SEE G ) | ( ) | |
| ELECTRICAL CONTROLS ( SEE M ) | ( ) | |
| ELECTRIC WIRING | ( ) | |
| SAFETY DEVICES | ( ) | |
| OPERATION | ( ) | |
| NWT INSPECTION | ( ) | |

**INSPECTED BY**

**DATE**

**Maintenance normally done every 182 days**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| AIR COMPRESSORS 1 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| BELTS & GEAR DRIVES | ( ) | |
| BELTS PULLEY & IDLERS | ( ) | |
| CRANKSHAFT | ( ) | |
| CONNECTING ROD | ( ) | |
| CROSSHEAD | ( ) | |
| CYLINDER | ( ) | |
| VALVES | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLAND | ( ) | |
| LUBRICATING SYSTEM | ( ) | |
| COOLING SYSTEM | ( ) | |
| RECEIVER TANK | ( ) | |
| AIR INTAKE & CLEANER | ( ) | |
| GAUGES | ( ) | |
| PRESSURE SWITCHES | ( ) | |
| UNLOADER | ( ) | |
| PIPING & VALVES | ( ) | |
| GUARDS | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |
| CLEANLINESS | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| AIR COMPRESSORS 2 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| BELTS & GEAR DRIVES | ( ) | |
| BELTS PULLEY & IDLERS | ( ) | |
| CRANKSHAFT | ( ) | |
| CONNECTING ROD | ( ) | |
| CROSSHEAD | ( ) | |
| CYLINDER | ( ) | |
| VALVES | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLAND | ( ) | |
| LUBRICATING SYSTEM | ( ) | |
| COOLING SYSTEM | ( ) | |
| RECEIVER TANK | ( ) | |
| AIR INTAKE & CLEANER | ( ) | |
| GAUGES | ( ) | |
| PRESSURE SWITCHES | ( ) | |
| UNLOADER | ( ) | |
| PIPING & VALVES | ( ) | |
| GUARDS | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |
| CLEANLINESS | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| WATER PUMP 1 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| IMPELLERS | ( ) | |
| VALVES & PIPING | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLANDS | ( ) | |
| INTAKE STRAINERS | ( ) | |
| GAUGES | ( ) | |
| LEVEL SWITCHES | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| E. PLANT AUXILIARIES | | NOTES |
|---|---|---|
| WATER PUMP 2 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| IMPELLERS | ( ) | |
| VALVES & PIPING | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLANDS | ( ) | |
| INTAKE STRAINERS | ( ) | |
| GAUGES | ( ) | |
| LEVEL SWITCHES | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| SUMP PUMP 1 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| IMPELLERS | ( ) | |
| VALVES & PIPING | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLANDS | ( ) | |
| INTAKE STRAINERS | ( ) | |
| GAUGES | ( ) | |
| LEVEL SWITCHES | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| E. PLANT AUXILIARIES | | NOTES |
|---|---|---|
| SUMP PUMP 2 | | |
| FOUNDATIONS | ( ) | |
| FRAMES | ( ) | |
| IMPELLERS | ( ) | |
| VALVES & PIPING | ( ) | |
| BEARINGS | ( ) | |
| PACKING GLANDS | ( ) | |
| INTAKE STRAINERS | ( ) | |
| GAUGES | ( ) | |
| LEVEL SWITCHES | ( ) | |
| ELECTRIC MOTORS ( SEE G ) | ( ) | |
| ELECTRIC CONTROLS ( SEE M ) | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| E. PLANT AUXILIARIES | | NOTES |
|---|---|---|
| STORAGE BATTERIES 125 VOLT | | |
| RACK | ( ) | |
| BASE PAD | ( ) | |
| CELL JARS & COVERS | ( ) | |
| PLATES - SEDIMENT | ( ) | |
| SEPARATOR | ( ) | |
| ELECTROLYTE | ( ) | |
| INTERCELL CONNECTORS & TERMINALS | ( ) | |
| HYDROMETERS & THERMOMETERS | ( ) | |
| SINK, FUNNELS & FILTERS | ( ) | |
| WATER STILL | ( ) | |
| DISTILLED WATER STORAGE | ( ) | |
| ACID STORAGE | ( ) | |
| OPERATION | ( ) | |
| VENTILATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| BATTERY CHARGER 125 VOLT | | |
| CONTROL EQUIPMENT (SEE M ) | **( )** | |
| TRANSFORMER | **( )** | |
| RECTIFIER ELEMENT | **( )** | |
| INSTRUMENTS | **( )** | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **E. PLANT AUXILIARIES** | | **NOTES** |
|---|---|---|
| STORAGE BATTERIES 48 VOLT | | |
| RACK | ( ) | |
| BASE PAD | ( ) | |
| CELL JARS & COVERS | ( ) | |
| PLATES - SEDIMENT | ( ) | |
| SEPARATOR | ( ) | |
| ELECTROLYTE | ( ) | |
| INTERCELL CONNECTORS & TERMINALS | ( ) | |
| HYDROMETERS & THERMOMETERS | ( ) | |
| SINK, FUNNELS & FILTERS | ( ) | |
| WATER STILL | ( ) | |
| DISTILLED WATER STORAGE | ( ) | |
| ACID STORAGE | ( ) | |
| OPERATION | ( ) | |
| VENTILATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| E. PLANT AUXILIARIES | | NOTES |
|---|---|---|
| BATTERY CHARGER 48 VOLT | | |
| CONTROL EQUIPMENT (SEE M ) | ( ) | |
| TRANSFORMER | ( ) | |
| RECTIFIER ELEMENT | ( ) | |
| INSTRUMENTS | ( ) | |

**INSPECTED BY**

**DATE**

**Maintenance normally done every 365 days**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **G. GENERATORS, MOTORS** | | **NOTES** |
|---|---|---|
| COMPONENTS | | |
| FOUNDATION, BASE, SUPPORTS | ( ) | |
| STATOR, FRAME | ( ) | |
| LAMINATION & POLE COMPONENTS | ( ) | |
| ROTOR, ARMATURE | ( ) | |
| AIR GAP | ( ) | |
| AIR FANS | ( ) | |
| WINDINGS | ( ) | |
| BANDING & SLASHING | ( ) | |
| SLOT WEDGES | ( ) | |
| BRUSHES | ( ) | |
| BRUSH RIGGING | ( ) | |
| SHAFT & BEARINGS | ( ) | |
| COUPLINGS | ( ) | |
| COOLING COILS | ( ) | |
| VENTILATION | ( ) | |
| FIRE SUPPRESSION SYSTEM | ( ) | |
| TEMPERATURE INDICATORS & RELAYS | ( ) | |
| WATER & OIL FLOW GAUGES & RELAYS | ( ) | |
| OIL SAMPLES | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| H. LOW-VOLTAGE SWITCHGEAR, BUSES & CABLES | | NOTES |
|---|---|---|
| OIL & AIR CIRCUIT BREAKERS | ( ) | |
| DISCONNECTING SWITCHES & FUSES | ( ) | |
| BUS BARS, JOINTS & CONNECTIONS | ( ) | |
| BUS INSULATORS & SUPPORTS | ( ) | |
| BUS ENCLOSURES & BARRIERS | ( ) | |
| SWITCHGEAR PANELS & ENCLOSURES | ( ) | |
| LOCKS & INTERLOCKS | ( ) | |
| WARNING & SAFETY SIGNS | ( ) | |
| CURRENT & POTENTIAL TRANSFORMERS | ( ) | |
| METERS, INSTRUMENTS & RELAYS | ( ) | |
| CONTROL DEVICES | ( ) | |
| PANEL WIRING | ( ) | |
| POWER CABLES | ( ) | |
| POTHAEDS | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| I. OIL & AIR CIRCUIT BREAKERS | | NOTES |
|---|---|---|
| TG 52-G1 | | |
| FOUNDATION | ( ) | |
| FRAME & TANKS | ( ) | |
| OIL VALVES & PLUGS | ( ) | |
| OIL LEVELS & GAUGES | ( ) | |
| BREATHERS & VENTS | ( ) | |
| PANELS & CABINETS | ( ) | |
| BUSHINGS OR INSULATORS | ( ) | |
| BUSHING CURRENT TRANSFORMERS & POTENTIAL DEVICES | ( ) | |
| MAIN TERMINALS & GROUND CONNECTIONS | ( ) | |
| MAIN CONTACTS | ( ) | |
| CONTACT PRESSURE SPRINGS | ( ) | |
| FLEXIBLE SHUNTS | ( ) | |
| MAGNETIC, AIR, OIL BLOWOUT DEVICES | ( ) | |
| CROSSHEAD | ( ) | |
| LIFT RODS & GUIDES | ( ) | |
| OPERATING RODS, SHAFTS & BELLCRANKS | ( ) | |
| CLOSING SOLENOID, AIR CYLINDER, MOTOR OR SPRING | ( ) | |
| MANUAL OPERATING DEVICE | ( ) | |
| AIR COMPRESSOR AND AIR TANK | ( ) | |
| LATCH AND TRIP MECHANISM | ( ) | |
| TRIPPING SOLENOID | ( ) | |
| CONTROL & PROTECTIVE RELAYS | ( ) | |
| SOLENOID VALVES | ( ) | |
| AUXILIARY SWITCHES | ( ) | |
| OPERATION COUNTER | ( ) | |
| POSITION INDICATOR | ( ) | |
| DASHPOTS OR SNUBBERS | ( ) | |
| MECHANISM CABINET | ( ) | |
| CABINET LIGHTS & HEATERS | ( ) | |
| POWER SUPPLIES & WIRING | ( ) | |
| OIL DIELECTRIC TEST | ( ) | |
| FILTER OIL | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| I. OIL & AIR CIRCUIT BREAKERS | | NOTES |
|---|---|---|
| TG 52-T2 | | |
| FOUNDATION | ( ) | |
| FRAME & TANKS | ( ) | |
| OIL VALVES & PLUGS | ( ) | |
| OIL LEVELS & GAUGES | ( ) | |
| BREATHERS & VENTS | ( ) | |
| PANELS & CABINETS | ( ) | |
| BUSHINGS OR INSULATORS | ( ) | |
| BUSHING CURRENT TRANSFORMERS & POTENTIAL DEVICES | ( ) | |
| MAIN TERMINALS & GROUND CONNECTIONS | ( ) | |
| MAIN CONTACTS | ( ) | |
| CONTACT PRESSURE SPRINGS | ( ) | |
| FLEXIBLE SHUNTS | ( ) | |
| MAGNETIC, AIR, OIL BLOWOUT DEVICES | ( ) | |
| CROSSHEAD | ( ) | |
| LIFT RODS & GUIDES | ( ) | |
| OPERATING RODS, SHAFTS & BELLCRANKS | ( ) | |
| CLOSING SOLENOID, AIR CYLINDER, MOTOR OR SPRING | ( ) | |
| MANUAL OPERATING DEVICE | ( ) | |
| AIR COMPRESSOR AND AIR TANK | ( ) | |
| LATCH AND TRIP MECHANISM | ( ) | |
| TRIPPING SOLENOID | ( ) | |
| CONTROL & PROTECTIVE RELAYS | ( ) | |
| SOLENOID VALVES | ( ) | |
| AUXILIARY SWITCHES | ( ) | |
| OPERATION COUNTER | ( ) | |
| POSITION INDICATOR | ( ) | |
| DASHPOTS OR SNUBBERS | ( ) | |
| MECHANISM CABINET | ( ) | |
| CABINET LIGHTS & HEATERS | ( ) | |
| POWER SUPPLIES & WIRING | ( ) | |
| OIL DIELECTRIC TEST | ( ) | |
| FILTER OIL | ( ) | |
| OPERATION | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **J. DISCONNECTS & FUSES** | | **NOTES** |
|---|---|---|
| BASE AND MOUNTING | ( ) | |
| INSULATORS | ( ) | |
| LINE & GROUND CONNECTIONS | ( ) | |
| BLADES & CONTACTS | ( ) | |
| CONTACT & HINGE SPRINGS & SHUNTS | ( ) | |
| ARCING HORNS | ( ) | |
| BLADE LATCHES & STOPS | ( ) | |
| OPERATING RODS, LEVERS & CRANKS | ( ) | |
| GEARBOXES | ( ) | |
| OPERATING MOTOR & MECHANISM | ( ) | |
| LOCKS & INTERLOCKS | ( ) | |
| AUXILIARY & LIMIT SWITCHES | ( ) | |
| SWITCH STICKS | ( ) | |
| FUSE TUBES | ( ) | |
| FUSE LINKS | ( ) | |
| MULTIPLE - SHOT RECLOSING FUSE | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| K. TRANSFORMERS & REGULATORS | | NOTES |
|---|---|---|
| TRANSFORMER 1 | | |
| TANKS & RADIATORS | ( ) | |
| OIL PIPING | ( ) | |
| VALVES & PLUGS | ( ) | |
| OIL LEVELS, GAUGES & RELAYS | ( ) | |
| RELIEF DIAPHRAGM | ( ) | |
| COOLING COILS & PIPING | ( ) | |
| COOLING FANS | ( ) | |
| TEMPERATURE INDICATORS & RELAYS | ( ) | |
| GAS REGULATOR, GAUGE & RELAYS | ( ) | |
| BUSHINGS | ( ) | |
| MAIN TERMINAL & GROUND CONNECTIONS | ( ) | |
| CORE & COILS | ( ) | |
| INTERNAL INSPECTION | ( ) | |
| TERMINAL BOARD & CONNECTIONS | ( ) | |
| RATIO ADJUST | ( ) | |
| TAP CHANGER OR REGULATOR | ( ) | |
| MOTOR & DRIVE | ( ) | |
| AUXILIARY & LIMIT SWITCH | ( ) | |
| POSITION INDICATORS | ( ) | |
| OPERATION COUNTER | ( ) | |
| POWER & CONTROL RELAYS | ( ) | |
| OPERATION | | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| K. TRANSFORMERS & REGULATORS | | NOTES |
|---|---|---|
| TRANSFORMER 2 | | |
| TANKS & RADIATORS | ( ) | |
| OIL PIPING | ( ) | |
| VALVES & PLUGS | ( ) | |
| OIL LEVELS, GAUGES & RELAYS | ( ) | |
| RELIEF DIAPHRAGM | ( ) | |
| COOLING COILS & PIPING | ( ) | |
| COOLING FANS | ( ) | |
| TEMPERATURE INDICATORS & RELAYS | ( ) | |
| GAS REGULATOR, GAUGE & RELAYS | ( ) | |
| BUSHINGS | ( ) | |
| MAIN TERMINAL & GROUND CONNECTIONS | ( ) | |
| CORE & COILS | ( ) | |
| INTERNAL INSPECTION | ( ) | |
| TERMINAL BOARD & CONNECTIONS | ( ) | |
| RATIO ADJUST | ( ) | |
| TAP CHANGER OR REGULATOR | ( ) | |
| MOTOR & DRIVE | ( ) | |
| AUXILIARY & LIMIT SWITCH | ( ) | |
| POSITION INDICATORS | ( ) | |
| OPERATION COUNTER | ( ) | |
| POWER & CONTROL RELAYS | ( ) | |
| OPERATION | | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **L. LIGHTNING ARRESTERS** | | **NOTES** |
|---|---|---|
| BASE & SUPPORTS | ( ) | |
| PORCELAIN SHELLS & INSULATORS | ( ) | |
| GRADING RINGS | ( ) | |
| ARRESTER UNITS ( INTERNAL ) | ( ) | |
| GAPS | ( ) | |
| WEATHER SHEDS & HOODS | ( ) | |
| LINE & GROUND CONNECTIONS | ( ) | |
| OPERATION INDICATORS | ( ) | |
| OPERATION TESTS | ( ) | |
| **INSPECTED BY** | | |
| **DATE** | | |

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| M. SWITCHBOARD & CONTROL EQUIP. | | NOTES |
|---|---|---|
| MOTOR STARTERS & CONTROLLERS | | |
| METAL BOXES & CABINETS | ( ) | |
| KNIFE SWITCHES | ( ) | |
| FUSES & CIRCUIT BREAKERS | ( ) | |
| CONTACTS | ( ) | |
| CONTACT SPRINGS & SHUNTS | ( ) | |
| BLOWOUT COILS & ARC CHUTES | ( ) | |
| OPERATING OR HOLDING SOLENOID & MAGNET FRAME | ( ) | |
| OPERATING SHAFT OR ROD | ( ) | |
| MECHANICAL & ELECTRICAL INTERLOCKS | ( ) | |
| LATCHES & TRIP DEVICES | ( ) | |
| AUXILIARY SWITCHES | ( ) | |
| OVERLOAD TRIP | ( ) | |
| STEP STARTER TIMERS | ( ) | |
| COMPENSATOR OR AUTOTRANSFORMER | ( ) | |
| MISCELLANEOUS CONTROL DEVICES | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **N. COMMUNICATION EQUIPMENT** | | **NOTES** |
|---|---|---|
| TELEPHONE EQUIPMENT | | |
| LINE PATROL | **( )** | |
| LINE LEAKAGE RESISTANCE | **( )** | |
| LINE LOOP RESISTANCE | **( )** | |
| MANUAL SWITCHBOARD | **( )** | |
| AUTOMATIC EXCHANGE | **( )** | |
| TRANSMITTERS, RECEIVERS, DIALS, RINGERS | | |
| MAGNETOS & SWITCH HOOKS | **( )** | |
| RINGING GENERATOR | **( )** | |
| BATTERIES | **( )** | |
| FUSES, HEAT COILS & ARRESTERS | **( )** | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **N. COMMUNICATION EQUIPMENT** | | **NOTES** |
|---|---|---|
| POWER LINE CARRIER EQUIPMENT | | |
| TUBES | ( ) | |
| CIRCUIT VOLTAGE & CURRENTS | ( ) | |
| A-LINE TUNED CIRCUITS IN TRANSMITTER, | | |
| RECEIVER & CHECK LINE TRAP | ( ) | |
| PROTECTIVE AIR GAP IN TUNING UNIT & | | |
| COUPLING CAPACITOR | ( ) | |
| TRANSMITTER - RECEIVER & CONTROL | ( ) | |
| LEAD - IN INSULATORS | ( ) | |
| HANDSETS, RINGERS & MAGNETOS | ( ) | |
| EQUIPMENT CABINETS | ( ) | |
| EMERGENCY BATTERIES | ( ) | |
| EMERGENCY MOTOR GENERATOR | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **N. COMMUNICATION EQUIPMENT** | | **NOTES** |
|---|---|---|
| RADIO TELEPHONES ( FIXED & MOBILE ) | | |
| ALL TRANSMITTER TEST | ( ) | |
| FREQUENCY | ( ) | |
| MODULATION % ( IF AM ) | ( ) | |
| MODULATION FREQUENCY DEVIATION (IF FM) | ( ) | |
| POWER OUTPUT | ( ) | |
| | | |
| TRANSMITTERS & RECEIVERS | | |
| TEST VOLTAGE & CURRENT | ( ) | |
| TUBES | ( ) | |
| ALIGNMENT & RECEIVER SENSITIVITY | ( ) | |
| ANTENNA & TRANSMISSION LINE | ( ) | |
| VENTILATION & DUST | ( ) | |
| ANTENNA TOWER | ( ) | |
| STANDBY POWER SUPPLY | ( ) | |
| MAIN POWER SUPPLY | ( ) | |
| | | |
| MOBILE STATIONS | | |
| BATTERY, BATTERY CABLE & CONNECTION | ( ) | |
| DYNAMOTOR | ( ) | |
| GENERATOR & VOLTAGE REGULATOR | ( ) | |
| ANTENNA | ( ) | |
| NOISE LEVEL | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| **N. COMMUNICATION EQUIPMENT** | | **NOTES** |
|---|---|---|
| SUPERVISORY & TELEMETRY EQUIP. | | |
| ELECTRONIC AMPLIFIERS, SIGNAL GENERATORS | ( ) | |
| TEST VOLTAGE & CURRENTS | ( ) | |
| TUBES | ( ) | |
| TELEMETER TRANSMITTERS & RECEIVERS & SWITCHBOARD RECORDERS | ( ) | |
| RELAYS | ( ) | |
| | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| O. SWITCHYARD & SUBSTATION | | NOTES |
|---|---|---|
| YARD & FENCE | ( ) | |
| BUILDINGS | ( ) | |
| WOOD STRUCTURES | ( ) | |
| STEEL STRUCTURES | ( ) | |
| FOOTINGS & GUY ANCHORS | ( ) | |
| GUYS | ( ) | |
| WARNING SIGNS | ( ) | |
| GROUND CONNECTIONS | ( ) | |
| CONDUCTORS & BUSES | ( ) | |
| HARDWARE | ( ) | |
| INSULATORS | ( ) | |
| TRANSFORMERS & REGULATORS | ( ) | |
| OIL & AIR CIRCUIT BREAKERS | ( ) | |
| DISCONNECTING SWITCHES & FUSES | ( ) | |
| LIGHTNING ARRESTERS | ( ) | |
| CONTROL EQUIPMENT | ( ) | |
| LIGHTING | ( ) | |
| OIL STORAGE FACILITIES | ( ) | |
| CONDUIT, DUCTS, TRENCHES & TUNNELS | ( ) | |
| STATIC CAPACITORS | ( ) | |
| STORAGE BATTERIES & CHARGERS | ( ) | |
| POWER SUPPLIES & WIRING | ( ) | |

**INSPECTED BY**

**DATE**

# TALTSON

## PLANT MAINTENANCE AND OPERATION
## INSPECTION & MAINTENANCE CHECK LIST

| P. TRANSMISSION LINES | | NOTES |
|---|---|---|
| WOOD POLES | ( ) | |
| CROSS ARMS | ( ) | |
| PINS | ( ) | |
| BRACES | ( ) | |
| STEEL TOWERS | ( ) | |
| FOOTINGS & GUY ANCHORS | ( ) | |
| GUYS | ( ) | |
| WARNING SIGNS | ( ) | |
| GROUND WIRES & COUNTERPOISE | ( ) | |
| MAIN CONDUCTORS & OVERHEAD GROUND WIRES | ( ) | |
| CONDUCTOR SPLICES | ( ) | |
| VIBRATION DAMPERS | ( ) | |
| GRADING SHIELDS & ARCING HORNS | ( ) | |
| HARDWARE | ( ) | |
| INSULATORS | ( ) | |
| RIGHT - OF - WAYS | ( ) | |
| LINE MAINTENANCE TRUCKS | ( ) | |
| LINE MAINTENANCE TOOLS | ( ) | |

**INSPECTED BY**

**DATE**

**Vehicle and Heavy Equipment maintenance**

## 3.3 Reference Manuals

The manuals for the operation and maintenance of any piece of equipment are kept in the respective plant, with a copy at the Fort Smith Office and on the computerized filing system.

# 4 Surveillance

## 4.1 Routine Inspections

4.1.1 The Taltson Operator does a visual inspection of each facility a minimum of every week

4.1.2 Inspection Sheet

**DAM INSPECTION**

| Check List | Comments | Complete |
|---|---|---|

**Crest**

| | | |
|---|---|---|
| Cracking: | | |
| Settlement: | | |
| Sinkholes: | | |
| Vegetation: | | |

Up Steam Face

| | | |
|---|---|---|
| Cracking: | | |
| Erosion: | | |
| Sinkholes: | | |
| Rip rap: | | |
| Instability: | | |
| Vegetation: | | |

**Downstream Face**

| | | |
|---|---|---|
| Cracking: | | |
| Erosion: | | |
| Sinkholes: | | |
| Rip rap: | | |
| Wet spots | | |
| Vegetation: | | |

**Toe**

| | | |
|---|---|---|
| Wet spots | | |
| Seepage | | |
| Ponding | | |
| Vegetation | | |

**Abutments**

| | | |
|---|---|---|
| Instability | | |
| Wet spots | | |
| Seepage | | |
| Erosion | | |
| Vegetation | | |

4.1.3 The results are evaluated by the South Slave Operations Manager, Plant Manager in Yellowknife and the System Control Manager then passed on to the Hydro Facilities Engineer.

## 4.2 Intermediate Inspections

4.2.1 The System Control Manager and representative from Engineering do an inspection of all facilities once a year.

4.2.2 Inspection Sheet

**NWTPC**
**SPILLWAY AND CONTROL STRUCTURE INSPECTION SHEET**

**CHECKLIST**

Operating Rules (2)
Slope Stability (2)
Erosion (2 or 3)
Debris Accumulation (3)
Concrete Condition (3)
Drains and Joints (3)

Obstruction of Discharge Channel (3)
Leakage Around Gates (3)
Debris in the Structure (2)
Erosion of Structure Backfill
Mechanical & Electrical Equipment (2)
Accessibility (2)

**Site Specific Concerns**

______________________________________________________________________
______________________________________________________________________

Dam: ____________ Reservoir Elev.______________ Date of Inspection:____________

Inspector(s): ________________________ Spillway Operating: ____________________
________________________ ____________________

Weather Conditions: ______________________________________________________________

**OBSERVATIONS**

Location & Item | Observation | Comments

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

**ITEMS REQUIRING ACTION:**

________________________________________________________

Inspector's Signature: __________________________ Date: __________________

**NOTE:** Bracketed numbers in checklist represent action codes.

**NWTPC**
**EMBANKMENT DAM AND DYKE INSPECTION SHEET**

**CHECKLIST**

| Crest | U/S Face | D/S Face | Toe | Abutments |
|---|---|---|---|---|
| Cracking (2) | Whirlpool (1) | Boils (1) | Boils (2) | Instability (1) |
| Sinkholes (1) | Cracking (2) | Wet Spots (2) | Wet Spots (2) | Seepage (2)\ |
| Settlement (2) | Instability (2) | Cracking (2) | Seepage (2) | Boils (1) |
| Slope Alignment (1) | Sinkholes (1) | Slope Instability (2) | Vegetation (3) | Wet Spots (2) |
| Vegetation (3) | Erosion (3) | Sinkholes (1) | Ponding (3) | Erosion (3) |
| Settlement above Conduit (1) | Riprap (3) | Erosion (3) | | Vegetation (3) |
| | Vegetation (3) | Piping Along Conduit (1) | | |
| | Lateral Movement (3) | Vegetation (3) | | |

**Site Specific Concerns**

______________________________________________________________

______________________________________________________________

Dam: __________ Reservoir Elev.: __________ Date of Inspection: ____________

Inspector(s): ________________ Spillway Operating: _____________________

Weather Conditions:

**OBSERVATIONS**

| Location & Item | Observation | Comments |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**ITEMS REQUIRING ACTION:**

____________________________________________________

Inspector's Signature: ________________________ Date: _____________________

**NOTE:** Bracketed numbers in checklist represent action codes.

4.2.3 Evaluation of Results

Results of the inspection are evaluated by the System Control Manager, Engineering, South Slave Operations Manager and the Hydro Region Director. All maintenance concerns are past on to the Hydro Maintenance Manager.

### 4.3 Comprehensive Inspections

4.3.1 A comprehensive inspection will be done every 5 years, or anytime the 24 hour precipitation exceeds 80 mm, or anytime the weekly precipitation exceeds 300 mm.

In the case of an earthquake in the Taltson Hydro area the System Control Manager shall immediately arrange for a general overall inspection of the dam and surrounding slopes.

4.3.2 Evaluation of Results

Results of the inspection are evaluated by the System Control Manager, South Slave Operations Manager, Corporate Engineering and the Hydro Maintenance Manager.

## 4.4 Required Instrumentation

4.4.1 There is no required instrumentation at the Taltson G.S.

## 4.5 Testing of Facilities

4.5.1 Responsibility

The Testing of any Facility would take the coordinated efforts of the Plant Manager, Hydro Maintenance Manager, System Control Manager and if required an engineer depending on the type of testing to be done.

4.5.2 Procedure

Procedures for testing the equipment, ( motors, pumps, headgates, stoplogs, controls and the like ) are kept in each plant, in a binder entitled Operating Procedures. A copy of this binder is kept in the Plant Manager and Hydro Maintenance Manager offices.

4.5.3 Frequency

All major components to the facilities such as headgates, stoplogs, governors and controls are tested annually. The motors and heaters are tested monthly. The pumps are tested by-weekly.

4.5.4 Checklist

Each plant has a Plant Maintenance and Operation Inspection & Maintenance Check List. That incorporates the dam and tailrace, power house, penstocks, turbines and governors, generators and motors, switchgear, breakers, disconnects and fuses, transformers, transmission lines and communication.

# 5 Reporting

## 5.1 Responsibility

**On Site Personnel / Control Center Operator shall report to:**

| | |
|---|---|
| Manager, Ops & Maint. South Slave - Ken Bell | 867-872-7110 (O)<br>867-872-5340 (H)<br>867-872-0452 (cell) |
| Manager, Ops & Maint. Mechanical – Aaron Martin | 867-669-3326 (O)<br>867-766-3541 (H)<br>867-445-3389 (cell) |
| Assistant Manager, Ops & Maint. Electrical<br>Robert Burgin | 867-669-3308 (O)<br>867-766-3328 (H)<br>867-444-8424 (cell) |
| Manager, Plant Operations – Colin Steed | 867-669-3327 (O)<br>867-920-4574 (H)<br>867-446-4712 (cell) |
| Director, Hydro Operations – Robert Schmidt | 867-669-3301 (O)<br>867-669 0858 (H)<br>867-445-6525 (cell) |
| Assistant Director, Hydro Ops – | 867- (O)<br>867- (H)<br>867- (cell) |
| Manager, System Control – Ken Dies | 867-669-3327 (O)<br>867-873-8034 (H)<br>867-445-6515 (cell) |

**Regional Director shall report to the following:**

| | |
|---|---|
| President & CEO – Emanuel DaRossa | 867-874-5276 (O)<br>867-874-4025 (H)<br>780-875-7694 (cell) |
| Director Corp. Operations – | 867-874- (O)<br>867-874- (H)<br>867-875- (cell) |
| Manager, Corp. Health, Safety & Envi. – Ed Smith | 867-874-5327 (O)<br>867-874-2491 (H)<br>867-875-7737 (cell) |

**Local Agencies (Fort Smith):**

| | |
|---|---|
| Fire or Emergency | 867-872-2222 |
| Ambulance | 867-872-3111 |
| Hospital | 867-872-6200 |
| RCMP | 867-872-1111 |
| Town of Ft. Smith | 867-872-8400 |

**Other important phone numbers:**

| | |
|---|---|
| GNWT Emergency Measure Organization | 867-873-7554 |

# Emergency Planning Phone List
# Updated: May 2012

## HAY RIVER HEAD OFFICE

| POSITION | NAME | WORK | HOME | FAX | CELL |
|---|---|---|---|---|---|
| President & CEO | Emanuel DaRosa | 874-5276 | 874-4025 | 874-5349 | 875-7694 |
| Executive Assistant | April Glaicar | 874-5258 | 874-6980 | 874-5229 | N/A |
| Mgr. Energy Serv. | Myra Berrub | 874-5223 | N/A | 874-5349 | N/A |
| Mgr. Perf. & Bench. | Eileen Hendry | 874-5265 | 874-4488 | 874-5349 | 875-8314 |
| Chief Financial Officer | Judith Goucher | 874-5234 | 874-3862 | 866-712-7241 | 875-7744 |
| Admin Assistant CFO | Darlene Lamb | 874-5331 | 874-3274 | 874-5251 | 875-7972 |
| Communications Mgr. | Bob Kelly | 874-5202 | 874-4857 | 888-332-9640 | 876-1095 |
| Mgr. Treasury & Enterprise Risk | Cory Strang | 874-5217 | 874-3102 | 874-5251 | 875-7676 |
| Treasury & Risk Ana. | Marlene McMeekin | 874-5332 | 874-3313 | 874-5251 | N/A |
| Contract Management | Tammy Schofield | 874-5211 | 874-3308 | 874-5214 | N/A |
| Controller | Belinda Whitford | 874-5219 | 874-3574 | 874-5251 | 780-991-9838 |
| A/P Clerk | Evellyn Coleman | 874-5241 | 874-2342 | 874-5214 | N/A |
| A/P Clerk | Donna Dean | 874-5329 | 874-2518 | 874-5214 | N/A |
| Capital Reporting | Vacant | | 875-7433 | 874-5251 | N/A |
| Fixed Asset Account. | Dorothy Jones | 874-5216 | 874-6179 | 874-5251 | N/A |
| AR/Collections | Jean Ramsay | 874-5247 | 874-6185 | 874-5251 | N/A |
| GL & FS Accountant | Lynn Harrison | 874-5207 | N/A | 874-5251 | 876-0037 |
| Acct. Rec. Clerk | Suzanne Bouchard | 874-5242 | 874-3144 | 874-5251 | N/A |
| Acct. Rec. H. Office Receptionist | Crystal Mackie | 874-5200 | 874-3412 | 874-5251 | N/A |
| Mgr. Internal Audit | Arlene Alcos | 874-5277 | 874-2146 | 874-5251 | 876-1016 |
| Consultant | Chris Polselli | 874-5227 | 780-571-4428 | 874-5251 | 780-893-6007 |
| Consultant | Ian Small | 874-5314 | N/A | 874-5251 | N/A |
| Mgr. Budgeting & Reg. Affairs | Terence Courtoreille | 874-5325 | 874-4662 | 874-5251 | 875-7734 |
| Sr. Financial Analyst | Drew Farmer | 874-5253 | 874-5777 | 874-5251 | N/A |
| Financial Analyst | Karen Mulligan | 874-5314 | N/A | 874-5251 | N/A |
| Management Acct. | Vacant | N/A | N/A | N/A | N/A |
| Manager, Logistics | Rod Gray | 874-5208 | 874-3103 | 874-5214 | 875-7733 |
| Purchasing Agent | Randy Williams | 874-5210 | 874-4844 | 874-5214 | 875-7151 |
| Stock Keeper | Vern Gardiner | 874-5298 | 875-4005 | 874-5214 | 875-7696 |
| Invent. Tech/Admin Support | Thess Cruzpe | 874-5222 | 874-3647 | 874-5214 | 875-7341 |
| Manager, HR | Cheryle Donahue | 874-5203 | 874-3887 | 874-5229 | 780 983-1709 |
| HR Officer | Sharmayne Horton | 874-5220 | 874-2488 | 874-5229 | N/A |
| HR Officer | Donna Munro | 874-5228 | 874-3557 | 874-5229 | N/A |
| Payroll Clerk | Pennie Pokiak | 874-5240 | 874-6763 | 874-5229 | N/A |
| Manager, IT | Glenn Smith | 874-5261 | 874-2990 | 874-5251 | 875-8287 |
| Network Sys. Analyst | Jim Forsyth | 874-5262 | 874-3655 | 874-5251 | 875-7731 |
| RM Coord. & IT Cons | Cheryl McMeekin | 874-5218 | 874-3102 | 874-5251 | N/A |
| IT Consultant | Matthew Walsh | 874-5296 | 874-2873 | 874-5251 | N/A |
| Business System An | Kerry Hataley | 874-5328 | 874-5858 | 874-5251 | |
| Business System An | D'arcy Delorey | 874-5206 | 874-2888 | 874-5251 | 876-0168 |
| Help Desk Consult. | Bill Gostick | 874-5295 | 874-2658 | 874-5251 | N/A |
| Mgr. Corp HSE | Edward Smith | 874-5327 | 874-2491 | 888-371-9433 Env.<br>888-458-4627 Safe. | 875-7737 |
| Env. Analyst | Joshua Clark | 874-5248 | 874-3509 | 888-371-9433 | 875-8212 |
| HSE Policy Coord. | David Dewar | 874-5249 | 874-4534 | 888-371-9433 | 875-7979 |
| Mechanical Ser. Mgr. | Dean Hendrickson | 874-5284 | 874-6875 | 874-5349 | 445-3811 |
| Electrical Tech. | Kirk Carston | 874-5209 | 874-2961 | 874-5349 | 875-2838 |
| Mgr. Fin. Thermal Rg Sr. Mgr. Customer S. | Paul Grant | 874-5254 | N/A | 874-5251 | N/A |
| Director, T&D | David Duncan | 874-5280 | N/A | 874-5286 | 875-7988 |
| Metering Technician | Jimmy Duggan | 874-5250 | N/A | 866-341-8918 | 875-8223 |
| Director, Asset Management & Eng. | Dan Roberts | 874-5283 | 874-2810 | 874-5286 | 875-7022 |
| Secretary | Patricia Harrington | 874-5282 | 874-2285 | 874-5286 | N/A |
| Mgr. Civil/Hydro Eng. | Vacant | 874-5213 | N/A | 874-5286 | N/A |
| Mgr. Elect. Section | Vacant | 874-5281 | | 874-5286 | 875-7739 |
| Mgr. Civil Section | Greg Haist | 874-5267 | 874-3213 | 874-5286 | N/A |
| Mgr. Thermal North Design Group | Jeremy Storvold | 874-5278 | 875-8640 | 874-5286 | 875-8640 |
| Spec. Eng. Mech. | Tim Farrell | 874-5204 | 874-6217 | 874-5286 | N/A |
| Project Mgr. | Peter Biggar | 874-5273 | 874-2329 | 874-5286 | N/A |
| Sr. Project Manager | Ian Flood | 874-5291 | N/A | 874-5286 | N/A |
| Mech. Tech. | Mitchell Touesnard | 874-5292 | 874-4648 | 874-5286 | N/A |
| Mech. Engineer | Vacant | 874-5225 | 874-2844 | 874-5286 | N/A |
| Elect. Engineer | Mark Riche | 874-5268 | 874-6146 | 874-5286 | N/A |
| Elect. Tech./Eng | Lena Liao | 874-5266 | N/A | 874-5286 | 875-7647 |

Doc. #867056 v2

# Emergency Planning Phone List
## Updated: May 2012

| | | | | | |
|---|---|---|---|---|---|
| Elect. Engineer | Vacant | 874-5291 | 874-2459 | 874-5286 | 867-669-3313 |
| Elect. Tech. | Henry Jiang | 874-5205 | N/A | 874-5286 | 875-2950 |
| Elect/SCADA Eng. | Bill Hayne | 874-5230 | 874-4783 | 874-5286 | N/A |
| Automation Tech. | Michael Song | 875-5330 | N/A | 874-5286 | 875-8914 |
| SCADA/Survalent | Allan Cunningham | 874-5226 | 874-3481 | 874-5286 | N/A |
| SCADA Tech. | Vacant | N/A | N/A | 874-5286 | N/A |
| Civil Engineer | Vacant | 874-5279 | N/A | 874-5286 | N/A |
| Drafting Tech. | Sarah Froese | 874-5239 | N/A | 874-5286 | N/A |
| Chief Draft Tech. | Annette Rupert | 874-5271 | N/A | 874-5286 | N/A |
| CADD Tech. | Lena Tao | 874-5271 | N/A | 874-5286 | N/A |
| Dist. Line Tech. | Will Mudry | 874-5272 | N/A | 874-5286 | N/A |
| Project Mgr. | Mark Horton | 874-5232 | 874-2488 | 874-5286 | N/A |
| Project Mgr. | Bradley Harrison | 874-5235 | 874-5938 | 874-5286 | 875-2923 |
| Buildings/Civil Eng. | Andrew Ellis | 874-5231 | N/A | 874-5286 | 778-899-4675 |

### INUVIK

| POSITION | NAME | WORK | HOME | FAX # | CELL |
|---|---|---|---|---|---|
| Director, Thermal | Mike Ocko | 777-7711 | 777-4535 | 777- 4318 | 445-6520 |
| Supply Chain Logistics | Glenn Colton | 777-7723 | 777-2227 | 777- 4283 | 678-5665 |
| Electrical Technician | Kirk Carston | 777-7713 | 777-4535 | 777-4318 | 875-2838 |
| Millwright | Mike Lawson | 777-7737 | N/A | 777- 4318 | 678-5587 |
| HD Mechanic | Ned Day | 777-7714 | N/A | 777-4318 | N/A |
| HD Mechanic | Kelly McLeod | 777-7736 | 777-3627 | 777-4318 | 678-5681 |
| Mechanic | Vacant | | | | |
| Electrical Serv. Supervisor | Gilles Ringuette | 777-7713 | 777-5848 | 777-4318 | 678-5778 |
| Electrician | Boyd Mallaley | 777-7735 | 777-4665 | 777-4318 | 678-5659 |
| Electrician | Marvin Simpson | 777-7734 | 777-5984 | 777- 4318 | 678-5653 |
| Appt Electrician | Tony McDonald | 777-7738 | N/A | 777-4318 | |
| Mgr. Gen. Support Beaufort/Delta | Bob Eldridge | 777-7718 | 777-4315 | 777- 4318 | 678-5673 |
| Plant Operator | Lawrence Neyando | 777-7725 | 777-5190 | 777- 4318 | 678-5686 |
| Plant Operator | Denis Rivard | 777- 7725 | 777-4198 | 777- 4318 | 678-5687 |
| Plant Operator | Ernest Bernhardt | 777-7725 | 777-3334 | 777-4318 | 678-5681 |
| Sr. Customer Service & Mgr. Fin.Therm. | Paul Grant | 777-7709 | 874-3137 | 777-4318 | 867-876-0439 |
| Customer Sv. Rep | Wilma Dosedel | 777-7732 | 777-3964 | 777- 4283 | 678-5353 |
| Customer Sv. Rep | Patricia Campbell | 777-7712 | N/A | 777-4283 | N/A |
| Customer Sv. Rep | Gerald Inglangasuk | 777-7710 | N/A | 777-4283 | N/A |
| Customer Sv. Rep | Jerry Lennie | 777-7744 | N/A | 777-4283 | N/A |
| Powerline Manager, Thermal Region | Dave Moline | 777-7701 | 777-3086 | 777-4318 | 678-5674 |
| Power Lineperson | Fernando Cardino | 777-7702 | 777-2811 | 777- 4318 | N/A |
| Power Lineperson | Edwin Tejuco | 777-7702 | N/A | 777-4318 | N/A |
| Power Lineperson | Clod Manalo | 777-7702 | N/A | 777- 4318 | N/A |

### FORT SIMPSON

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Director Thermal | Mike Ocko | Inuvik | N/A | Inuvik | 445-6520 |
| Manager Cust. Service | Todd Roche | 695-7106 | 695-3709 | 695-7111 | 444-0370 |
| Customer Service Rep | Trudy Nelner | 695-7100 | 695-3937 | 695-7111 | N/A |
| Mgr. Gen. Support Deh Cho/Sahtu | Daniel Bruneau | 695-7104 | 695-3422 | 695-7111 | 445-2013 |
| Heavy Duty Mechanic | Vacant | 695-7109 | 695-2215 | 695-7111 | N/A |
| Heavy Duty Mechanic | Rob Douglas | 695-7102 | 695-2829 | 695-7111 | N/A |
| Electrician | Derek Blake | 695-7103 | N/A | 695-7111 | N/A |
| Electrician | Darrell Littlechild | 695-7114 | 695-2758 | 695-7111 | N/A |
| Trades helper/Operator | Todd Simms | 695-7105 | 695-3847 | 695-3522 | N/A |
| Plant Operator | Darren Squirrel | 695-7105 | 695-2971 | 695-3522 | 872-8059 |
| Plant On Call Cell | N/A | N/A | N/A | N/A | 620-0054 |
| Line On Call Cell | N/A | N/A | N/A | N/A | 695-6547 |
| Lineperson Cell | N/A | N/A | N/A | N/A | 6956779 |
| Power Lineperson | Kerry McKinley | 695-7114 | 695-2158 | 695-7111 | N/A |
| Power Lineperson | Allan McDonald | 695-7107 | 695-3993 | 695-7111 | N/A |
| Mgr. O & M Thermal | Dean Hendrickson | 777-7719 | 874-6875 | 888-413-2724 | 445-3811 |

Doc. #867056 v2

# Emergency Planning Phone List
# Updated: May 2012

### AKLAVIK

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Michael Greenland | 978-2003 | 978-2137 | 978 -2004 | 978-2250 |
| Alternate | Randy Edwards | 978-2740 | 987-2133 | 978 -2004 | N/A |

### COLVILLE LAKE

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Alvin Orlias | 709-2800 | 709-2407 | 709-2818 | 709-2006 |
| Casual Plant Operator | Dennis Blaneho | 709-2800 | 709-2003 | 709-2818 | N/A |

### DELINE

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Tommy Betsidea | 589-3502 | 589-3823 | 589-4504 | 589-4423 |
| Casual Plant Operator | Andy Mackeinzo | 589-3502 | 589-3688 | | |

### FORT GOOD HOPE

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Stanley McNeely | 598-2277 | 598-2938 | 598-2122 | 598-2138 |
| Casual Operator | James Masuzumi | 598-2188 | | | |

### FORT LIARD

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Ed Wood | 770-4290 | | 770-4289 | 770-4707 |
| Casual Plant Op. | Tom Wieselman | | | | |

### FORT MCPHERSON

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Hugh Robert | 952-2201 | 952-2761 | 952-2000 | 952-2023 |

### ULUKHAKTOK

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Edward Kaodloak | 396-3403 | 396-3005 | 396-3103 | 396-3022 |
| Casual Operator | Mark Kaodloak | 396-3305 | | | |

### JEAN MARIE RIVER

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Vacant | 809-2600 | N/A | 809-2500 | N/A |

### NAHANNI BUTTE

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | James Tonka | 602-2401 | 602-2272 | 602-2831 | 602-2402 |

### NORMAN WELLS

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Contractor | Global Tech. | 587-3425 | N/A | 587-3424 | 587-2789 |
| Plant Operator | Robert Closs | 587-3425 | N/A | N/A | N/A |
| Alternate | Val/Daryl MacGregor | 587-2072 | 587-2414 | 587-2074 | N/A |

### PAULATUK

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Casual Plant Supt. | Francis Ruben | 580-3141 | 580-3142 | 580-3501 | 580-3020 |
| Casual | Desmond Ruben | 580-3141 | 580-3813 | 580-3501 | N/A |

### SACHS HARBOUR

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Richard Carpenter | 690-4546 | 690-3501 | 690-3902 | 690-4501 |
| Casual | Jock Carpenter | 690-4546 | 690-3000 | N/A | N/A |

### TULITA

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Darren Moorman | 588-4291 | | 588-4501 | 588-3205 |

### TUKTOYAKTUK

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Contractor | Richard Cockney | 977-2512 | 977-2472 | 977-2261 | 678-5681 |
| Alternate | Richard Gruben | 977-2488 | 977-2488 | N/A | N/A |

Doc. #867056 v2

# Emergency Planning Phone List
## Updated: May 2012

### TSIIGEHTCHIC

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Phillip Andre | 953-3512 | 953-3344 | 953-3614 | 953-3210 |

### WRIGLEY

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Michael Pellissey | 581-3591 | 581-3323 | 581-3614 | 584-3713 |

### YELLOWKNIFE

| POSITION | NAME | WORK | HOME | FAX# | CELL |
|---|---|---|---|---|---|
| Director, Hydro | Robert Schmidt | 669-3301 | 669-0858 | 866-635-0471 or 669-3316 | 445-6525 |
| Special Projects | Randy Waddell | 669-3306 | 873-4322 | 669-3316 | 445-6514 |
| HR Officer | Roberta Cochrane | 669-3304 | 873-9601 | 669-3356 | 445-9601 |
| Billings Coordinator | Erin Ladouceur | 669-3307 | 669-0860 | 866-482-8231 | N/A |
| Finance Manager | Mustansar Nadeem | 669-3302 | 874-4289 | 669-3316 | N/A |
| Customer Svc. Rep | Vacant | 669-3303 | N/A | 669-3316 | N/A |
| Training Coordinator | Vacant | 669-3312 | N/A | 888-696-5406 | N/A |
| Customer Srv Rep | Clauditte Maisog | 669-3300 | N/A | 669-3316 | N/A |
| Mgr. System Control | Ken Dies | 669-3327 | 873-8094 | 669-3316 | 445-6515 |
| System Operator | Doug Sanders | 669-3370 | 873-6756 | 669-3316 | N/A |
| System Operator | Richard Taggart | 669-3370 | 873-3685 | 669-3316 | N/A |
| System Operator | Steven James | 669-3370 | 873-4968 | 669-3385 | 445-6488 |
| System Operator | Kevin Dunn | 669-3340 | 445-6989 | 669-3316 | 445-6989 |
| System Operator | John Vanthull | 669-3370 | 445-8600 | 669-3385 | N/A |
| System Operator | Robbie MacIntosh | 669-3370 | 669-0770 | N/A | 444-0321 |
| Mgr. Mech. Services | Aaron Martin | 669-3326 | 766-3541 | 669-3316 | 445-3389 |
| Maintenance Planner | Morris Callahan | 669-3329 | 873-3014 | 669-3316 | N/A |
| Maint. Plan/Spec Projects | Stuart Robinson | 669-3328 | 873-6449 | 669-3316 | 445-6512 |
| Powerline Manager, Thermal Region | Vacant | 669-3355 | N/A | 669-3316 | N/A |
| Power Lineperson | Deaon Hope | 669-3334 | 445-6053 | 669-3316 | 445-6053 |
| Power Lineperson | Keith Doran | 669-3334 | 920-7394 | 669-3316 | 445-5234 |
| Power Lineperson | Darren Hazenberg | 669-3334 | 873-5574 | 669-3316 | 446-3335 |
| Power Lineperson | Dean Kenny | 669-3334 | N/A | 669-3316 | 445-6511 |
| Mgr. Electrical Serv. | Robert Burgin | 669-3308 | 766-3328 | 669-3316 | 444-8424 |
| Electrical Technician | Mervin Penney | 669-3349 | 873-2915 | 669-3316 | N/A |
| Electrician | Bob Norton | 669-3338 | 873-9791 | 669-3316 | N/A |
| Electrician | Robert Sunderland | 669-3338 | N/A | 669-3316 | 444-9062 |
| Millwright | Keith Smith | 669-3380 | 873-2030 | 669-3316 | 445-3380 |
| Millwright | Roger Cater | 669-3341 | 669-9495 | 669-3316 | N/A |
| Manager, Plant Ops | Colin Steed | 669-3347 | 920-4574 | 669-3316 | 446-4712 |
| Plant Operator | Joe St. Croix | 669-3341 | 920-7170 | 669-3316 | N/A |
| Plant Operator | Ryan Sutherland | 669-3341 | 444-6882 | 669-3316 | N/A |
| Plant Operator | Wayne Mercredi | 669-3338 | 873-5826 | 669-3316 | N/A |
| Plant Operator | Reg Croizier | 669-3341 | 873-3789 | 669-3316 | N/A |
| Plant Operator | Les Watsyk | 669-3341 | N/A | 669-3316 | N/A |
| Plant Operator | Tony Waiter | 669-3341 | N/A | 669-3316 | N/A |
| Plant Operator | Michael Dunn | 669-3341 | N/A | 669-3316 | N/A |
| Plant Proc/Training Officer | Norm McBride | 669-3341 | 920-2885 | 669-3316 | N/A |
| Diesel Maint. Planner | Morris Callahan | 669-3329 | 873-3014 | 669-3316 | N/A |
| Diesel Mechanic | Craig Janz | 669-3380 | 920-2831 | 669-3316 | N/A |
| Diesel Mechanic | JP Landry | 669-3380 | 873-4439 | 669-3321 | 445-3953 |
| Web Dev/ IT Cons. | Leigh Hufty | 766-5080 | 920-7257 | 669-3316 | 445-8482 |
| Mgr. Tech Services | Tom Deleff | 669-3331 | 873-2284 | 669-3316 | 445-6519 |
| Radio/Comm. Tech. | Bruce Fowler | 669-3351 | N/A | 669-3320 | 445-5462 |
| Supply Logistics | Rick Scott | 669-3336 | 873-9496 | 669-3318 | 445-6517 |
| Stock Keeper | Mark Plotner | 669-3335 | N/A | 669-3318 | 445-6517 |
| Regional H&S Coord. | Brian Campbell | 669-3310 | 873-4175 | 888-458-4627 | 445-6524 |
| Regional H&S Coord. | Vacant | 669-3311 | N/A | 888-458-4627 | 445-6530 |

### FORT SMITH

| POSITION | NAME | WORK | HOME | FAX # | CELL |
|---|---|---|---|---|---|
| Director Hydro | Robert Schmidt | 669-3301 | 669-0858 | 866-635-0471 or 669-3316 | 445-6525 |
| Mgr., Ops & Maint. SS | Ken Bell | 872-7110 | 872-5340 | 872-7149 | 872-0452 |
| Customer Svc. Rep | Marilyn Bennett | 872-7115 | 872-2626 | 872-7149 | N/A |
| Electrician | Vacant | 872-7125 | | 872-7149 | 872-0126 |
| Electrician/Operator | Clem Longpre | 872-7106 | 872-4905 | 872-7149 | N/A |
| Plant Operator | John Davenport | 872-7103 | 872-4782 | 872-7149 | N/A |
| Plant Operator | Yves Leguerrier | 872-7113 | 872-4523 | 872-7149 | N/A |
| Power Lineperson | Duane Rohne | 872-7120 | 872-4945 | 872-7149 | 872-0766 |
| Power Lineperson | James Dasti | 872-7120 | 872-3409 | 872-7149 | 872-0766 |
| App Power Lineperson | Trevor Wetmore | 872-7120 | 872-3032 | 872-7149 | 444-8789 |

Doc. #867056 v2

# Emergency Planning Phone List
## Updated: May 2012

| | | | | | |
|---|---|---|---|---|---|
| App Power Lineperson | Raul Mendoza | 872-7120 | 872-5129 | 872-7149 | 872-8257 |
| App Power Lineperson | Ronel Joloya | 872-7120 | 872-5129 | 872-7149 | N/A |
| Trades Helper | John Cazon | 872-7100 | 872-2234 | 872-7149 | 872-8124 |

### FORT RESOLUTION

| POSITION | NAME | WORK | HOME | FAX # | CELL |
|---|---|---|---|---|---|
| Contractor | Louis Balsillie | 394-4401 | 394-5911 | 394-4226 | N/A |

### LUTSEL K'E

| POSITION | NAME | WORK | HOME | FAX # | CELL |
|---|---|---|---|---|---|
| Plant Superintendent | Gerry Jonasson | 370-3001 | 370-3442 | 370-3956 | N/A |

### GAMETI

| POSITION | NAME | WORK | HOME | FAX # | CELL |
|---|---|---|---|---|---|
| Plant Superintendent | Joanna Chocolate | 997-3421 | 997-3773 | 997-3906 | 997-3421 |
| Casual Operator | Frank Rabesca | 997-3421 | 997-3418 | 997-3906 | N/A |

### WHATI

| POSITION | NAME | WORK | HOME | FAX # | PLC |
|---|---|---|---|---|---|
| Plant Superintendent | Charlie Simpson | 573-3002 | 573-3402 | 573-3402 | N/A |
| Casual Operator | Michael Rabesca | 573-3002 | 573-3782 | 573-3402 | N/A |

### NTEC 03 LTD.

| POSITION | NAME | WORK | HOME | FAX | CELL |
|---|---|---|---|---|---|
| Mgr. Business Dev. | Andrew Stewart | 766-5077 | 920-7849 | 669-3395 | N/A |

### CHAIRMAN'S OFFICE

| POSITION | NAME | WORK | HOME | FAX | CELL |
|---|---|---|---|---|---|
| Chairman | Brendan Bell | 766-5081 | N/A | 669-3395 | N/A |
| Corporate Secretary | Cheryl Tordoff | 766-5076 | 920-7664 | 669-3395 | 446-6221 |
| Manager, Hydro Adv. | Peter Lennie-Misgeld | 766-5084 | N/A | 669-3395 | N/A |
| Admin. Assistant | Cynthia Breland | 766-5085 | N/A | 669-3395 | N/A |
| Mgr, Hydro Develop. | David Mahon | 766-5090 | N/A | 669-3395 | N/A |
| Bus. and Energy Dev. | Geraldine Byrne | 766-5079 | 873-2791 | 669-3395 | N/A |

**HAY RIVER MEETING ROOMS**

| | |
|---|---|
| Main Boardroom | 874-5224 (Phone on Side Table) |
| Main Boardroom | 874-5324 (Conference Phone on Table) |
| Executive Boardroom | 874-5323 |
| Engineering Boardroom | 874-5269 |
| Warehouse Meeting Room | 874-5212 |

**IRIDIUM SATELLITE PHONES**

To call an Iridium from a land line; example; 011-8816-3165-4284, this will call the Bluefish Control Center.

| | |
|---|---|
| Bluefish | 8816-3165-4284 |
| Snare | 8816-3165-4285 |
| YK Control | 8816-5142-6022 |
| Whati | 8816-3165-4922 |
| Gameti | 8816-3165-4928 |
| Lutsel Ke | 8816-3158-8883 |
| Franks Channel (Rae) | 8816-3165-5495 |
| Fort Simpson Operations | 8816-3146-7127 |
| | 8816-5143-2887 |
| | 8816-5142-6111 |
| Inuvik Director Thermal | 8816-5142-4838 |
| Director of Engineering | 8816-3146-6666 |

Doc. #867056 v2

# Emergency Planning Phone List
## Updated: May 2012

### Apartments/Transient Houses

**Hay River:**
**#3A Park Place – 874-4857**
**#3D Park Place – 874-4025**
**#204 Smith Building – 874-4149**
**#206 Smith Building – 874-2768**

**Yellowknife:**
**#408 Capital Suites – 669-6453**
**#301 Fraser Tower – 669-3317**

**Inuvik:**
**#15 Raven – 777-2811**
**#17 Raven – 777-3086**

### Media Contacts

**CBC Studio Line 669-3600**
**Messages – 873-4928**
**GM - John Agnew 445-3870**

**CJCD Studio 920-2523**
**GM – Ilene Dent 445-9196**

**CKLB Studio 920-2277**
**GM – Dane Gibson 445-8360**
**William Greenland 445-8361**
**Andrais 765-4982**

City of YK –Mayor Van Tighem
**920-5693**

**Taltson Hydro Site**
**872-5328**
**Fax – 874-5312**
**Sat Phone – (403)997-4485**

**Snare Rapids Plant – 669-6896**
**Snare Falls Plant – 669-6898**
**Snare Cascades Plant – 669-6899**
**Snare Tyesub – 669-6893**

**to dial out , on the new snare voip phone. Dial 9 to access an outside line.**

**Example…to call Control in YK, dial "9, 669-3370"**

**Central Control Room – (867) 669-3370**
**Bluefish Hydro Plant / Operator – (867) 669-3381**
**Bluefish Fax – (867) 669-3382**
**Bluefish Camp Main Office – (867) 669-6889**

**Yellowknife Region Line Emergencies – (867) 445-4291**

Doc. #867056 v2

## 5.2 Inspection Results

All inspections results are passed to the Hydro Maintenance Manager, the System Control Manager , the Director of Engineering and the Hydro Region Director.

## 5.3 Regular Reporting

The Operator on site reports all maintenance items to the Plant Manager and the System Control Manager. The maintenance items are then passed on to the Hydro Maintenance Manager and if the maintenance items are large in scope or costs, the, Hydro Region Director and the Director of Engineering.

# Figures

Figure 1

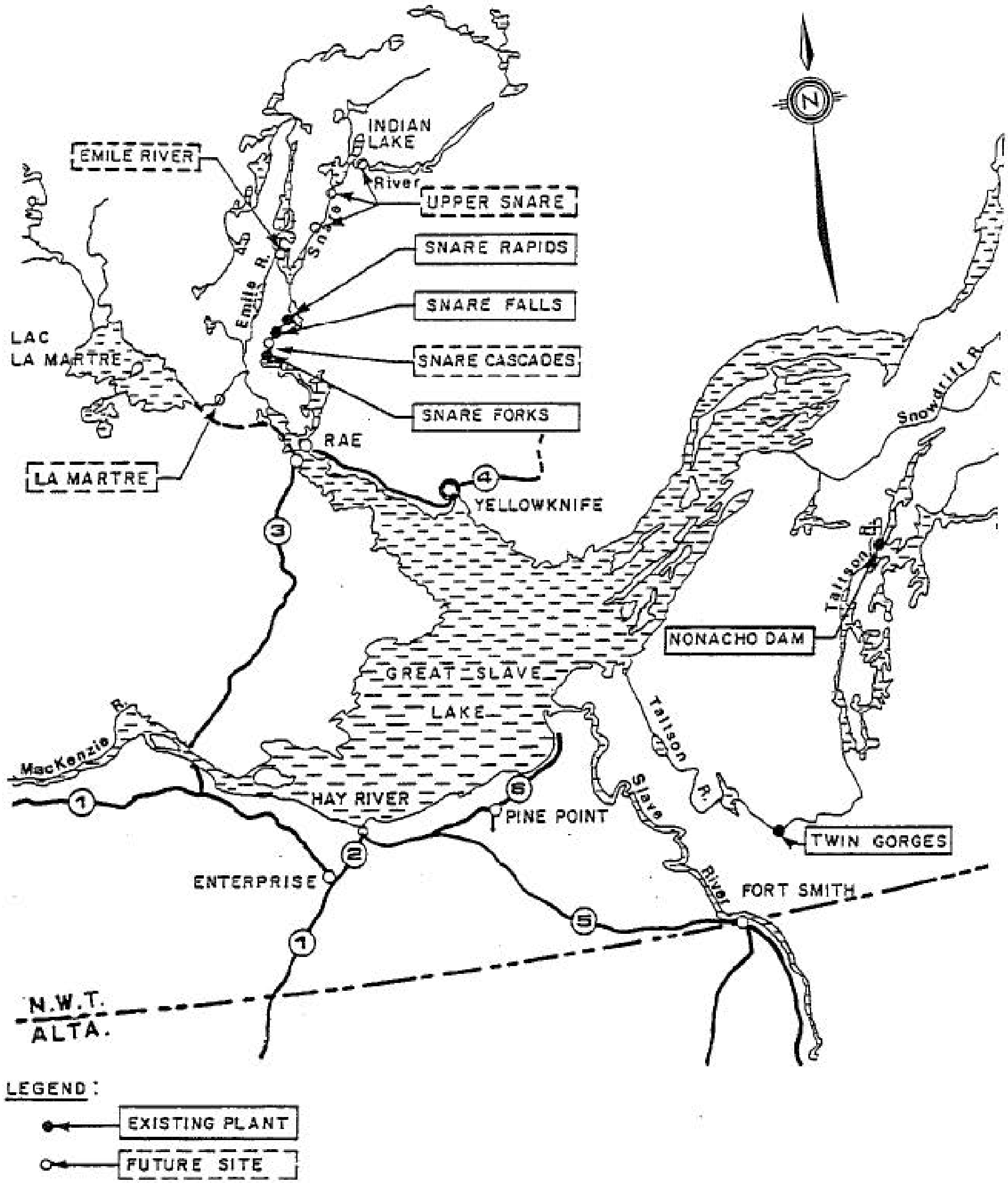


Figure 2

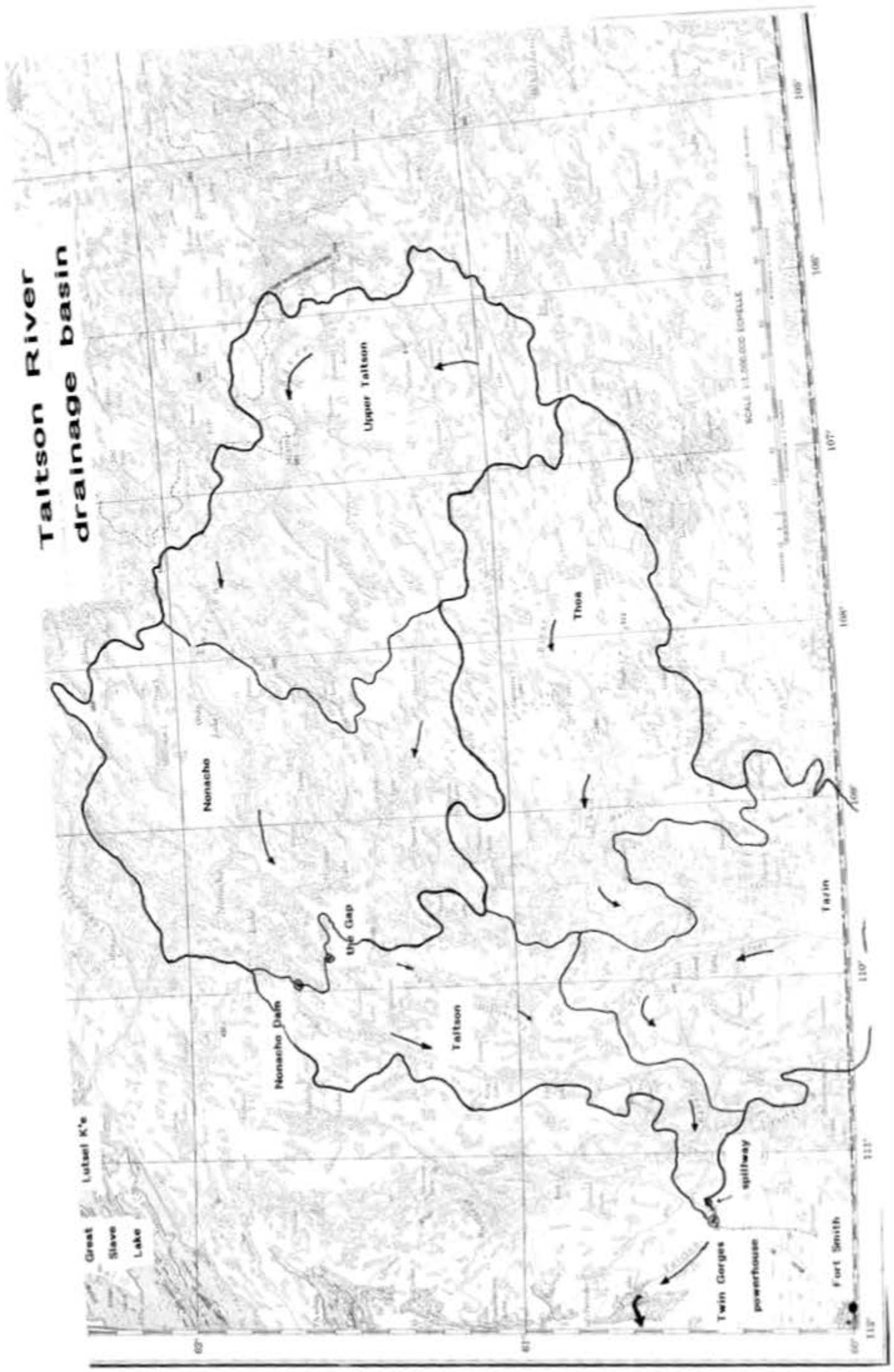

Taltson River drainage basin
Upper Taltson
Thoa
Nonacho
the Gap
Taltson
Nonacho Dam
Tazin
Lutsel K'e
Great Slave Lake
Twin Gorges
powerhouse
spillway
Fort Smith

Figure 3

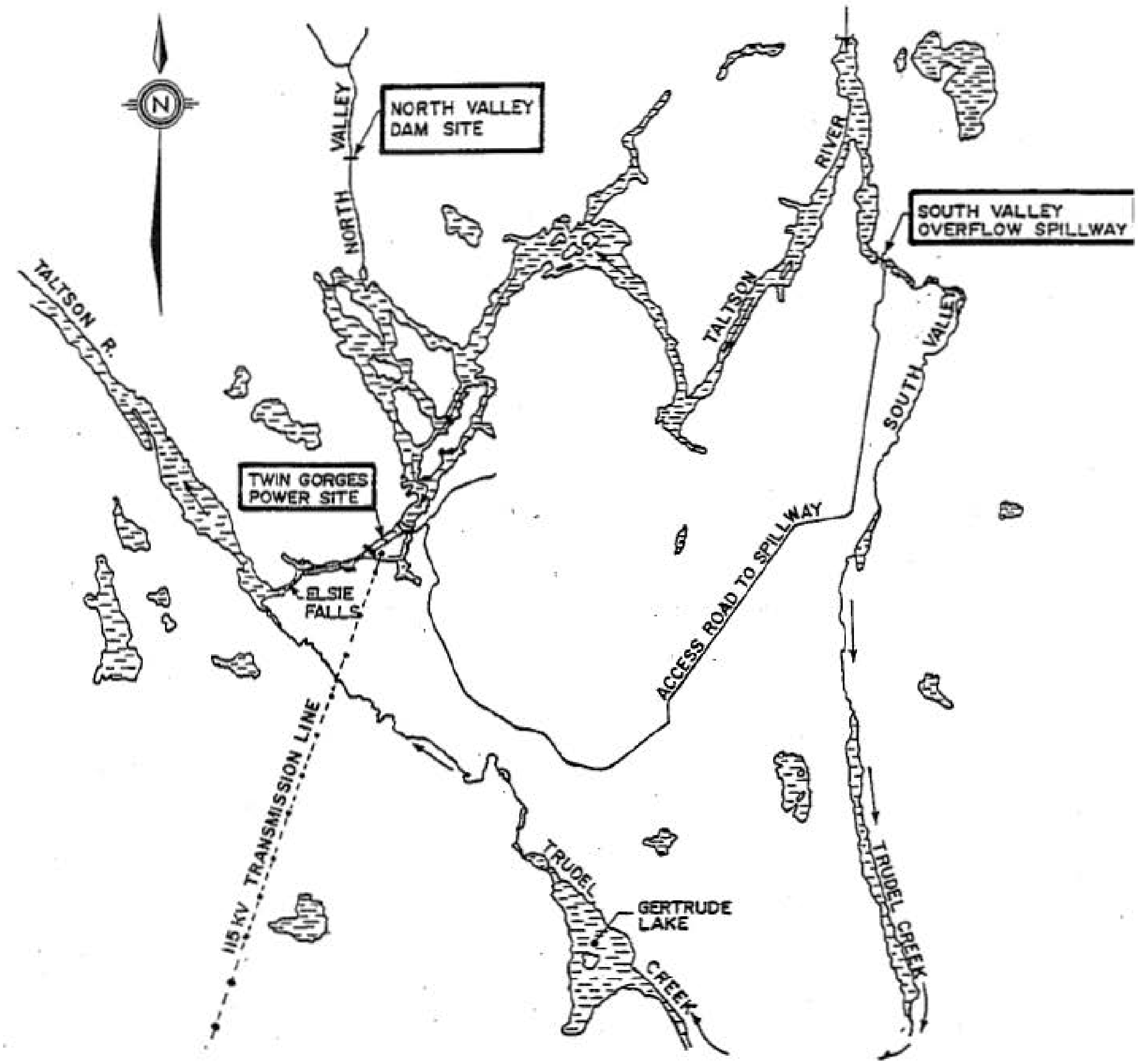

N
NORTH VALLEY
DAM SITE
NORTH VALLEY
SOUTH VALLEY
OVERFLOW SPILLWAY
TALTSON RIVER
TALTSON R.
SOUTH VALLEY
TWIN GORGES
POWER SITE
ELSIE
FALLS
ACCESS ROAD TO SPILLWAY
115 KV TRANSMISSION LINE
TRUDEL
GERTRUDE
LAKE
CREEK
TRUDEL CREEK

Figure 4

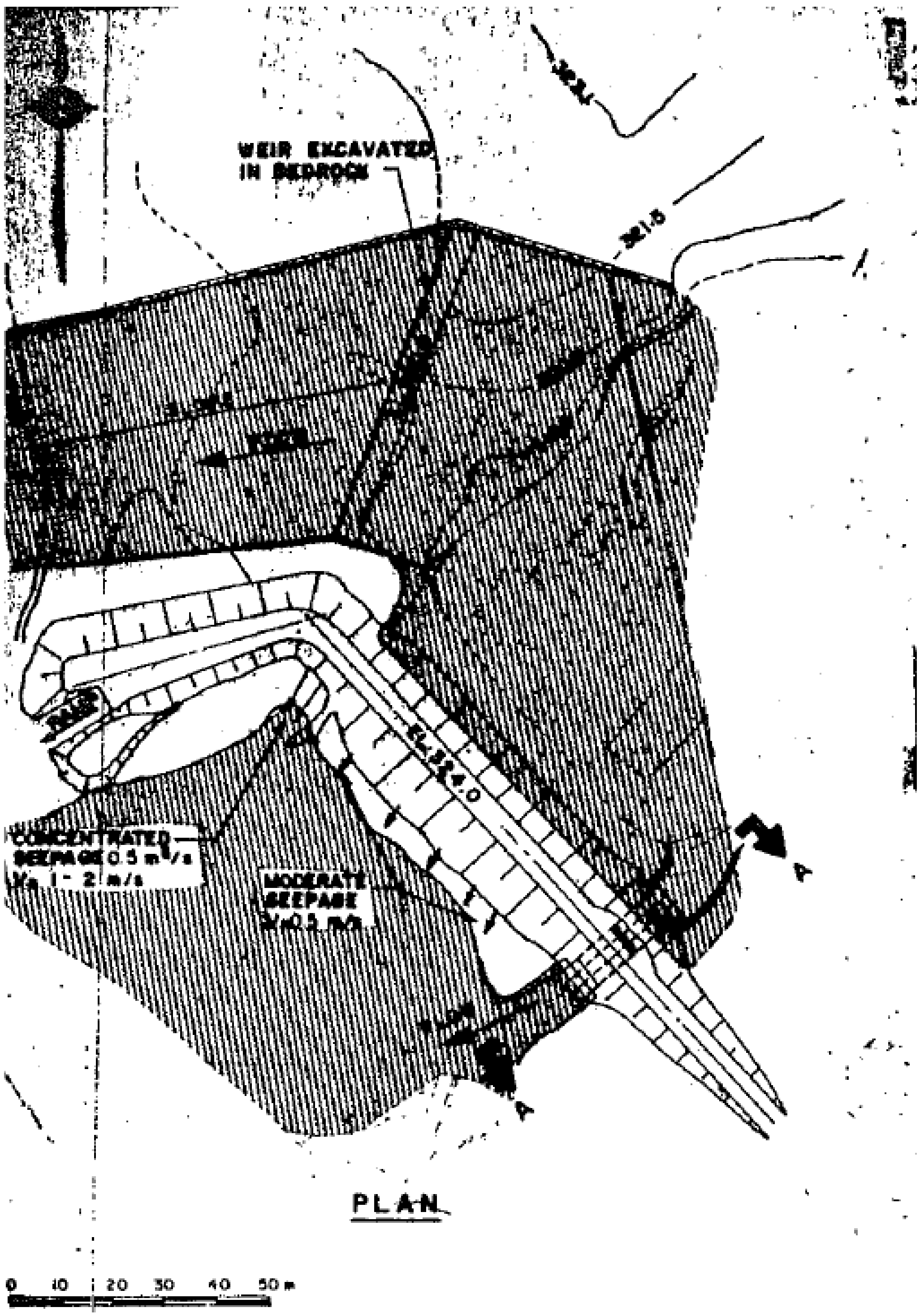
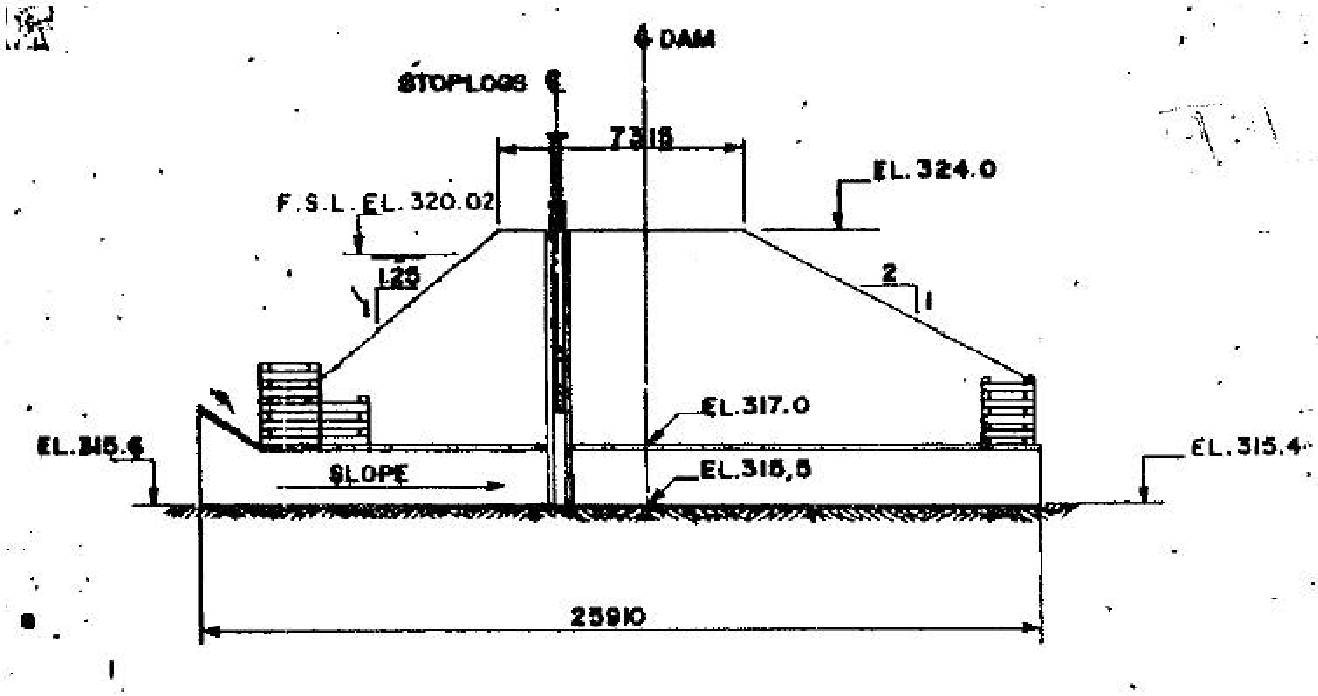
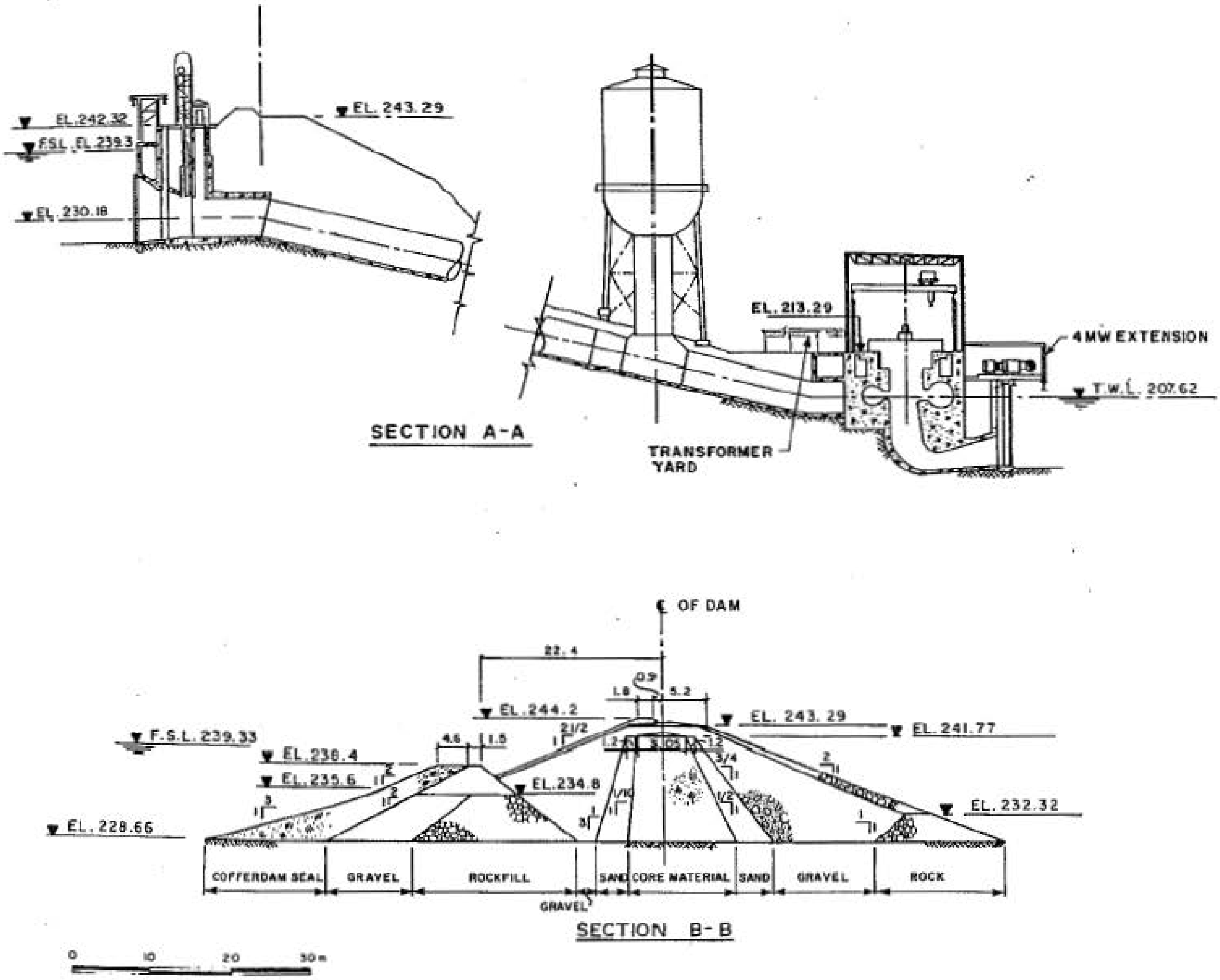

WEIR EXCAVATED IN BEDROCK
EL 334.0
CONCENTRATED SEEPAGE 0.5 m³/s V= 1 - 2 m/s
MODERATE SEEPAGE V=0.5 m/s
A
A
PLAN
0 10 20 30 40 50 m

Figure 5



DAM
STOPLOGS
7315
EL. 324.0
F.S.L. EL. 320.02
1.25
1
2
1
EL.317.0
EL.315.6
SLOPE
EL.315.5
EL.315.4
25910

Figure 6


EL. 242.32
F.S.L. EL. 239.3
EL. 230.18
EL. 243.29
EL. 213.29
4 MW EXTENSION
T.W.L. 207.62
SECTION A-A
TRANSFORMER YARD
OF DAM
22.4
0.9
1.8
5.2
EL. 244.2
EL. 243.29
EL. 241.77
F.S.L. 239.33
EL. 236.4
EL. 235.6
EL. 234.8
EL. 228.66
EL. 232.32
4.6
1.5
COFFERDAM SEAL
GRAVEL
ROCKFILL
SAND
CORE MATERIAL
SAND
GRAVEL
ROCK
GRAVEL
SECTION B-B
0
10
20
30 m

# Appendix “A”

## Isolation, Detection & Reporting of HPU Problems

# Maintenance

This section of the manual has been developed by L&S Electric, Inc., to aid in the proper maintenance and troubleshooting of L&S Electric, Inc.'s Automated Control System and associated equipment.

The L&S Electric, Inc., Automated Control System is generally maintenance free. There are, however, configuration and calibration tasks that may become necessary equipment failure and / or replacement. This section also includes regular maintenance guidelines for associated hydraulic equipment. Those procedures will be discussed in this section of the manual.

NOTE: Caution ***must*** be exercised to avoid contacting live components, when performing maintenance procedures.

# Fuse Replacement

When fuse replacement is necessary, use the following guidelines to ensure correct and safe fuse installation.

1. Ensure that the system is shutdown.

2. Follow the company standard practice for replacement of fuses.

3. Choose a corrective action to remedy the condition that caused the fuse failure. Some conditions to check should include:

    - Short circuit
    - Ground fault
    - Faulty equipment

4. Replace the blown fuse with the appropriate equivalent fuse. Refer to the Electrical Elementary drawings, Panel Assembly drawings and the Bill of Materials for fuse part number and specifications. Note that typically time delay fuses are used for branch circuits supplying power to motors, solenoids, power supplies, and field YO; while fast acting fuses should he used to protect equipment such as PLC modules, U 0 bases, meters, and transducers.

# Oil Filter Element Part Numbers

| Equipment | Fitter Element Manufacturer | Fitter Element Part Number | L&S Part Number |
|---|---|---|---|
| Universal Pilot Manifold | Schroeder Industries | N3 | PS001283 |
| Pump Suction Strainer | Flow Ezy | P-5-1-100-RV3 | PS001695 |

# Isolation, Detection and Reporting of HPU Problems

Warning: This fault detecting procedure is intended as a reference to systematic faultfiildings in a hydraulic system. **L&S** Electric (to the extent permitfed by law) accepts no liability for toss or damage suffered as a result of the use of this guide. If in doubt, a1wa.y~ refer to the original equipment manufacturer.

Topics covered in this section include:

- Isolating HPU Problems
- Detecting HPU Problems
- Reporting HPU Problems

# Isolating HPU Problems

**Isolating Malfunctions and Failures within Hydraulic Power Unit (HPU)**

Once a problem has been detected, maintenance personnel must keep in mind some general rules before attempting to perform any repairs or continue fault finding in hydraulic machines:

**Guidelines:**

1. Before working on a machine, check the effect on interlocked parts or machines.

2. Chock up cylinders and parts that may fail under gravity.

3. Isolate electrical supply and lock control cabinet

4. Isolate pump and ensure it cannot be started accidentally.

5. Bleed hydraulic fluid to relieve any pressure in the system.

6. Plug all pipe ends and ports of components to keep out contaminants.

7. Ensure that components stripped are marked to facilitate correct assembly.

8. Wash components in the correct fluid. If in doubt, use clean hydraulic fluid as used on the machine.

9. Use torque wrenches for tightening components. Do not over tighten.

10. Use extreme care when starting the machine for the first time after re-work. A pipe left off can cause flood of oil; a valve spool reversed may cause a cylinder to open instead of close; actuators may operate out of sequence.

**Scenarios for Isolating Components for Maintenance or Replacement Purposes:**
**Pump and/or Motor (MI, M2 or M3)**

1. If running, shutdown governor unit.

2. Apply gate lock, if applicable.

*NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves may cause piping and / or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.*

# Isolating HPU Problems

3. Place pump / motor control selector switches to the OFF position and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

5. Verify system pressure reads zero.

6. Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Switch OFF and tag the pump/motor's individual power supplies. Pull fuse if required by current maintenance practices.

9. Close and tag corresponding pump suction and delivery isolating valves when working on pump circuit.

10. Pump / motor could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

11. Cover and / or plug all hydraulic connections, as required,

12. Do not leave the hydraulic system unattended.

13. Follow Initial Start-Up instructions when ready to re-establish normal HPU operating conditions.

**Pump Relief Valve**

1. If running, shutdown governor unit.

2. Apply gate lock, if applicable.

*NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and/or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.*

3. Place pump / motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve

5. Verify system pressure reads zero.

# Isolating HPU Problems

*6.* Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Switch OFF and tag the pump / motor's individual power supply. Pull fuse if required by current maintenance practices.

9. Close and tag corresponding pump suction and delivery isolating valves when working on pump circuit.

10. Pump relief valve could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

11. Cover and / or plug all hydraulic connections, as required.

12. Do not leave the hydraulic system unattended.

13. Verify relief valve setup, and adjust as required, before releasing the HPU for normal operation.

14. After finishing the work, assure that unit is ready to be released operational.

15. Run system unloaded for approximately 15 minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**Accumulator Bank Relief Valve**

1. If running, shutdown governor unit.

2. Apply gate lock, if applicable.

*NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and/or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.*

3. Place pump / motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

5. Verify system pressure reads zero.

# Isolating HPU Problems

6. Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Accumulator relief valve could now be safely removed to repair and/or replace. Follow manufacturer's instructions, as required.

9. Cover and /or plug all hydraulic connections, as required.

10. Do not leave the hydraulic system unattended.

11. Verify relief valve setup, and adjust as required, before releasing the HPU for normal operation.

12. After finishing the work, assure that unit is ready to be released operational.

13. Run system unloaded for approximately 15 minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**System Drain Valve**

1. If running, shutdown governor unit.

2. Apply gate lock, if applicable.

***NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and / or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.***

3. Place pump / motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

5. Verify system pressure reads zero.

6. Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Close and tag pump isolating valves

# Isolating WPU Problems

9. System drain valve could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

10. Cover and/or plug all hydraulic connections, as required.

11. Do not leave the hydraulic system unattended.

12. After finishing the work, assure that unit is ready to be released operational

13. Run system unloaded for approximately 15 minutes, that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**Hydraulic Manifold**

1. If running, shutdown governor unit,

2. Apply gate lock, if applicable.

*NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and/or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure raring.*

**3.** Place pump / motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

5. Verify system pressure reads zero.

6. Close and tag servomotor shut off valves

7. Close and tag accumulator bank shut off valve.

8. Close and tag pump isolating valves.

9. Manifold assembly could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

10. Cover and/or plug all hydraulic connections, as required.

11. Do not leave the hydraulic system unattended.

12. After finishing work, assure that unit is ready to be released operational

# Isolating HPU Problems

13. After re-installing the manifold assembly, run system unloaded for approximately **15** minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**Control Valve Stacks**

1. If running, shutdown governor unit

2. Apply gate lock, if applicable.

***NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and / or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.***

3. Place pump/motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

5. Verify system pressure reads zero.

6. Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Close and tag pump isolating valves.

9. Control valving could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

10. Cover and/or plug all hydraulic connections, as required.

11. Do not leave the hydraulic system unattended.

12. After finishing work, assure that unit is ready to be released operational.

13. After re-installing the valving, run system unloaded for approximately 15 minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**Accumulator Bank**

# Isolating HPU Problems

1. If running, shutdown governor unit.

2. Apply gate lock, if applicable.

*NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and / or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.*

3. Place pump / motor control selector switches to the OFF position, and tag.

4. Depressurize hydraulic system by opening the bypass valve on LS 400 valve.

**5.** Verify system pressure reads zero.

6. Close and tag servomotor shut off valves.

7. Close and tag accumulator bank shut off valve.

8. Read charging block pressure gauge. Verify that pressure reading corresponds to that of nitrogen precharge setting or below.

9. Release nitrogen precharge.

10. Read charging block pressure gauge. Verify that pressure reading is zero.

11. Accumulator bladder could now be safely removed to repair and/or replace. Follow manufacturer's instructions, as required.

12. Cover and/or plug all hydraulic connections, as required.

13. Do not leave the hydraulic system unattended.

14. Precharge accumulator hank as required, before releasing the HPU for normal operation.

15. After finishing the work, assure that unit is ready to be released operational.

16. Run system unloaded for approximately 15 minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

**Wicket Gate Servomotor**

1. If running, shutdown governor unit.

# Isolating HPU Problems

2. Apply gate lock, if applicable.

***NOTE: Locking the hydraulic cylinders under pressure, by using shut off valves, may cause piping and / or hose rupture given a condition that could lead to a pressure spike with a magnitude higher than that of the component burst pressure rating.***

3. De-water the turbine.

4. Place pump / motor control selector switches to the OFF position, and tag.

5. Depressurize hydraulic system by opening the bypass valve on LS 400 valve

6. Verify system pressure reads zero.

7. Close and tag servomotor shut off valves.

8. Close and tag accumulator shut off valve,

9. Close and tag pump isolating valves.

10. Servomotor(s) could now be safely removed to repair and / or replace. Follow manufacturer's instructions, as required.

11. Cover and / or plug all hydraulic connections, as required.

12. Do not leave the hydraulic system unattended.

13. After finishing the work, assure that unit is ready to be released operational.

14. Run system unloaded for approximately 15 minutes; that is, open the drain valve and run pumps. This will aid in releasing any trapped air in the hydraulic fluid.

***NOTE: Cycle wicket gates several times, using governor Test Mode***

# Detecting HPU Problems

A guide is provided in the *Manufacturer 's Support Information* section of the *Appendix* that outlines a systematic approach to troubleshooting and detecting HPU problems. The Guide *"Logical Troubleshooting in Hydraulic Systems"* is the copyrighted material of Vickers, Incorporated.

# Reporting HPU Problems

**Reporting Malfunctions and Failures**

Malfunction and failure reports aid maintenance personnel in troubleshooting and shortening downtime on machines where the same fault has previously occurred. It also helps maintenance management in putting forward a scheme of preventive maintenance. It may also be useful to the plant management in determining the reliability of different types of components within the system, and influence the purchase of such or highlight the necessity for a design modification.

Therefore, it is recommended to keep a record of breakdowns which includes, at a minimum, the following information:

| Machine # | Symptom | Cause | Remedy of Fault | Date & Time | Downtime Length |
|---|---|---|---|---|---|

# Associated Hydraulic Equipment Maintenance

There are three simple maintenance procedures, which are important for maintaining an efficient hydraulic system:

1. Maintaining a clean, sufficient quantity of hydraulic fluid of the proper type and viscosity.

2. Changing filters and cleaning strainers regularly

3. Keep all connections tight, but not to the point of distortion, in order to prevent air from entering the system.

The instructions presented in this section of the manual will cover those and other procedures, which if followed, may ensure long and reliable operation of hydraulic components.

# Industrial Hydraulic Oil

The term "industrial hydraulic oil" refers to petroleum-based oil, which has been carefully refined to remove chemicals that are not compatible with components in a hydraulic system. Industrial hydraulic oil contains additives to retard rust and minimize foaming. If you want to mix different brands of hydraulic oil, consult your oil company representative to see if they are compatible.

### Viscosity

Viscosity is the rating of the oil's thickness (resistance to flow), and is considered to be the single most important characteristic. Viscosity is always expressed as a certain number, at a certain temperature. In the United States, the most common viscosity unit is the Saybolt Universal Second, abbreviated SSU.

The hydraulic pump is usually the component most sensitive to viscosity. The pump manufacturer's recommendation on viscosity should be closely followed. .Oil that is too light (thin) may excessively by-pass the pump, cylinder and valves. The result is excessive pressure and power loss, oil heating and cylinder slowdown. Oil that is too heavy may starve the pump inlet (called cavitation). This causes excessive pump wear, cylinder slowdown, further power loss, and erratic operation of the system.

### Temperature

As a hydraulic system is put into operation, the oil warms up until it reaches a steady temperature. The heat is generated at the same rate that it is radiated to the atmosphere or removed by a heat exchanger.

Keeping the oil temperature to a moderate level is an important requirement to maintain an efficient and trouble free unit. To obtain optimum service life from both the oil and the hydraulic system, operate the system between 100 degrees F (38' C), and 110 degrees F (43' C). The minimum oil temperature recommended by L&S Elecmc, Inc., is 80 degrees F (27" C); maximum oil temperature recommended is 140 degrees F (60" C).

# Industrial Hydraulic Oil

Chemical processes such as oxidation (combining with oxygen in the air) and the reaction with minute quantities of acids (which may have been formed from moisture condensing in the oil) are caused by excessive oil temperature, and will shorten oil life. The impurities formed in the oil resemble lacquers and varnishes, which are referred to as ***sludge.*** These impurities clog filters, strainers, and small orifices. They reduce lubricity in the oil, which accelerates wear on metal-to-metal moving parts.

The occurrence of early failure of pumps, excessive oil leakage, oil leakage from pump and cylinder shaft seals, spool sticking in valves, and general malfunctioning of the system are the result of excessive oil temperature.

There is no harm in operating a hydraulic system with cold oil if the oil viscosity at the operating temperature is suitable for the pump. Damage comes from cold weather starts, when the oil is so thick it will not flow in sufficient volume to the pump inlet. Running a pump against its relief valve for an hour or so to warm the oil may permanently damage the pump.

**System Oil Reservoir Fill-Up**

Prior to filling the system oil reservoir, confirm that the reservoir is completely clean. Any contamination shall be removed. For this system, L&S Electric, Inc., recommends the use of Mobil DTE *25* (IS0 VG 46 @ 40oC)**,** or an approved equivalent.

NOTE: ***Do not use cloth strainers or fluid that has been stored in contaminated containers. Use at feast a No. I20 mesh screen when filling-up the reservoir.***

Fill the reservoir supplied with L&S Electric, Inc.'s electrical / hydraulic governor to its rated capacity. To monitor the fill-up of the reservoir, use the supplied oil level gauge located on the side of the reservoir. After filling the system, tightly close the reservoir filler / breather.

If oil level in sump changes, check the accumulator precharge before adding or removing oil. The normal operating level of the sump depends on the accumulator precharge. If the precharge is too low, more oil is needed in the accumulators to reach the same pressure than if

# Industrial Hydraulic Oil

precharge was at the correct pressure. This results in the sump level appearing low when it is actually the accumulators that need attention. Adding oil without checking the precharge could result in an oil overflow in the sump when the accumulators are drained. Refer to the *Accumulator Maintenance and Inspection* section of this manual for the precharge procedure

## Oil Contamination

Refiners of hydraulic oils take particular care to prevent contamination of any sort from entering the oil up to the time of delivery. It is just as important to exercise care in preventing contaminants from entering the oil after its delivery, and during storage and handling. The following sections provide instructions for this purpose.

Contamination in hydraulic systems is now recognized as the most frequent cause of malfunction or failure of hydraulic equipment. Dependent on the nature, size andlor amount of contaminant, it can cause:

1. Reduced component sewice life.

2. Machine malfunction, particularly when operating near maximum capacity.

3. Risk of frequent breakdowns under the same conditions.

Contamination can be either particle contamination, or the product of fluid degradation. Particle contamination can be metal, rubber, plastic, dirt, dust, fiber, sand, paint, etc.; several types may be present at any time. Particulates can enter the fluid at any time after the fluid manufacturer has produced the fresh clean fluid.

Fluid degradation results in:

1. Oxidation and/or the formation of gummy deposits and sludge, which results from the combined effects of high temperatures, air, water and particle contamination. These can increase viscosity, cause gummy deposits to coat moving parts, clog orifices and small passages, all of which impair smooth mechanical movements.

# Industrial Hydraulic Oil

2. Unstable emulsions of poor lubricity formed when water accidentally emulsifies with oil. These impair smooth movements and promote wear.

3. Aeration / air bubbles in the fluid, particularly at low pressures. In excess, they cause noise in pumps and valves leading to erratic or spongy machine movements, premature wear and failure.

A contaminated system can be the result of several factors which include inadequate system design, poor system maintenance, poor system housekeeping, and adverse operating conditions.

**1. Inadequate system design**

a. Reservoirs which cannot be cleaned.

b. Breathers that permit abrasives, inherent in the atmosphere to enter the system.

c. Poor cylinder packing design (no wiper to clean dirt from the piston rod).

d. Improper piston rod design (piston rods with poor wear characteristics).

e, Improper valving (anti-cavitation checks omitted from cylinder circuits with rapid drop characteristics).

f. Failure to provide adequate filtration.

**2. Poor system maintenance**

a. Improper and unclean practices when adding fluid to the system.

b. Failure to clean breathers.

c. Failure to change pitted cylinder rods and worn cylinder packing.

d. Failure to use good cleanliness practices when changing system components.

e. Failure to change filter cartridges and / or fluid at proper intervals.

f. Failure to purge debris from the system after a pump failure.

# Industrial Hydraulic Oil

**3. Poor housekeeping of the system.**

a. Surgical cleanliness is not required; however, ordinary clean practices during assembly will pay off in increased service life of the equipment.

b. Excessive and improper use of pipe thread sealer on lines and gaskets in the system can cause pump failures. This is especially true when a type of sealer is used that hardens.

c. Another source of contamination is fittings, hoses and lines which are received from a vendor uncapped. The use of brazed or welded fittings, and unpicklcd steel plating can also contribute to the contamination.

**4. Adverse operating conditions**

a. Experience shows, that machines used in a very dusty atmospheres and in windy areas require special components. For example, heavy-duty breathers, chrome plated piston rods, plus frequent changes of the filter cartridges are also required.

**Oil Contamination Affects**

Contamination affects all types of hydraulic equipment adversely. Precision high tolerance parts are very susceptible to the effects of contamination. Dirty fluid causes wear which accelerates leakage and the development of heat in a system. Heat lowers the lubricity of a hydraulic fluid and causes additional wear.

**Storing Hydraulic Oil**

Care must be taken from the minute oil is delivered, to keep it clean. The first step is selecting a clean, coot, dry spot for storage. Store the oil drums on their sides and cover them to prevent dust accumulation.

To avoid condensation in storage, drums must be protected against sudden temperature changes and should be kept full. Water collecting on the top of a drum will seep through the plug and into the oil. Water in hydraulic oil will reduce reliability and service life, regardless of the manufacturer's claims of the oil's ability to function with water contamination.

# Industrial Hydraulic Oil

Keep hydraulic oil in original containers and tightly sealed. Never store oil in an open container where it can collect dust.

**Handling Hydraulic Oil**

Before opening a drum, wipe the top carefully so that dirt will not fall into the oil. If, by chance, dirt does get into the oil, make sure the oil is cleaned before using.

Most large particles can be removed by straining through a 100-mesh screen. Remove the remaining dirt by allowing it to settle in the oil. Using only the clean oil from the top of the container may waste some oil, but it could prove to be very worthwhile in keeping the system clean.

Never try to salvage oil spilled on the floor unless you intend to reprocess it (if equipment is available, filter or centrifuge the oil).

Remember, however, that active earth types of filters (such as Fullers Earth) remove oil additives. Consult your oil company representative or filter manufacturer if you're not sure. When drawing oil out of storage, make certain it is carried from storage point to use in clean, covered containers. If the oil drawn out of storage is not used immediately, make sure it is kept tightly covered.

**Filling the System with Hydraulic Oil**

Before removing filler cap to add oil to a hydraulic system, wipe off the fill plug and the filler nozzle with a clean, lint-free cloth. The safest way to pour oil from a container into a reservoir is to use a 10-micron filter on the filler nozzle. It is especially important at this point to watch for metallic chips, bits of waste, and other contaminants that may cause damage to the hydraulic system. The reservoir should be tightly closed after filling the system.

Avoid putting used oil into the power unit. Discharge old oil taken from the power unit unless the quantity involved is sufficient to justify setting up a filtering or centrifuging arrangement to reprocess it.

# Industrial Hydraulic Oil

It is risky to mix brands. Many times these are compatible but occasionally some unusual condition exists that would cause trouble.

*NOTE: L&S Electric recommends the use of Mobil DTE 25 (IS0 VG 46 @ 40°C), or an approved equivalent.*

## Contamination Control During Component Replacement

If a pump, motor, or any other hydraulic component should fail, the system becomes contaminated. For reducing contamination while replacing the damaged component, remove the unit for repair. The reservoir must be drained, flushed and cleaned. All hoses, lines cylinders and valves should he inspected for wear and particles of the unit that failed.

- Flush all components of the complete system to remove metallic particles. Replace filter elements. Dispose of the fluid removed from the system and fill the reservoir with clean hydraulic fluid.

- Install a new or rebuilt component and start up the system, allowing it to run for a period of time to verify normal operation.

- Filter elements should be changed after 40 or 50 hours of operation.

*NOTE: Following these guidelines will guarantee the system to be essentially clean and free of any residue of the failed component.*

## Hydraulic Oil Changes

Good maintenance procedures make it mandatory to keep the hydraulic fluid clean. A daily/weekly or monthly log should be kept on the hydraulic fluid condition.

No hard and fast rule can be established for changing the fluid because of the great variety of operating conditions. However, when filter elements are replaced frequently, service life of a system increases. Periodic testing of the fluid by the supplier is recommended to confirm suitability for continued use and to establish the correct fluid and filter element replacement interval.

# Industrial Hydraulic Oil

Some of the considerations affecting hydraulic fluid life are: operating temperature, type of service, contamination levels, filtration, and the chemical composition of the fluid.

**Draining the System**

The system should be started and fluid heated before draining. This will lower the time it takes to drain the system and allow impurities suspended in the fluid to be removed. It is desirable to remove all fluid from the system. Bleeding of the fluid at the lowest point in the system will help in most cases.

Systems which have accumulated deposits that were not removed during draining must be flushed with a light viscosity fluid. The fluid should contain a rust inhibitor to protect metal surfaces against rust formation after draining.

When hydraulic fluid is added to replenish the system, it should be pumped through a ***25-*** micron filter. If such a fitter is not available, a funnel with a fine wire screen (120 mesh or finer) can be used. It is important that fluid be clean and fiee of all substances which will cause improper operation.

**Aeration**

Aeration is the formation of air bubbles in the system, resulting from the entrainment of air in the oil. Air bubbles in the system produce rapid energy losses in the form of heat and noise; therefore, aeration should be avoided. The following are candidates for the formation of air in a system.

1. Leaking inlet lines.

2. Control valve O-rings leaking

**3.** Pump shaft seal leakage.

4. Leaking cylinder packing caused by cavitating cylinders.

5. Turbulence or sloshing in the reservoir.

6. Vortexing fluid in the reservoir

7. Release of air suspended within the fluid.

# Industrial Hydraulic Oil

**Effects of Aeration**

Aeration can be in many forms: large bubbles, foam or in various degrees of suspension. It usually causes pump noise (cavitation). Small bubbles cause extreme and rapid component wear. Larger bubbles could cause hydraulic components to collapse.

**Aeration Control and Cures**

1. Leaking Inlet Lines.

a. Pipe threaded fittings can be porous. Use an approved type of pipe thread sealer on all pipe threads.

b. If the pump inlet flange surface is rough, scored or mutilated, air leakage past the 0-ring seal can result.

***Note: With any of the above defects, air can be pulled into the system***

2. Control Valve 0-Rings Leaking.

a. "0" rings are used to seal against port leakage in many control valves. These seals can be checked by applying heavy grease around the part to be checked. If the noise stops, the trouble has been located and repair can be initiated.

b. On systems which have been operating at excessive high temperatures, the "0" rings can harden and take a set. If this occurs, air leakage can result. This is true not only in a pump, but also in the rest of the components of the system.

c. Another factor enhancing air leakage is the actual fluid composition. Fluids which have a high sulfur content tend to accelerate "0" ring hardness. This is one of the principle reasons for keeping system operating temperatures down.

d. Normal operating temperature of a system is between 100°F (38°C) and 1 10°F (43'C). When operating temperatures are in excess of 140°F (6OoC), trouble may result. Maximum operating temperatures should be checked at the pump outlet port.

# Industrial Hydraulic Oil

**3. Leaking Cylinder Packing Caused By Cavitating Cylinders**.

a. On applications where a rapid raise and lower cycle is experienced, air can enter the system through a cylinder rod seal.

b. Vacuums in excess of 20 inches of mercury have been recorded in systems without anti-cavitation check valves. This is enough to force dirt particles past the shaft seal into the system with the air.

c. An anti-cavitation check will allow flow from the reservoir to enter the rod area of the cylinder during a vacuum condition. Anti-cavitation checks should always be used to prevent a high vacuum condition from developing. This will lower the possibility of fluid contamination through the rod seal of a working cylinder.

**4. Turbulence or Sloshing in the Reservoir Return lines**

a. If improperly located, return lines can cause turbulence and aeration. Retun lines emptying above the fluid level cause bubbles to form in the system. Return lines should always be terminated below the fluid level. Reservoir must be deep enough to prevent aeration.

**5. Vortexing Fluid In the Reservoir**

a. If the fluid level in the reservoir is low and the inlet demand is great, a vortex condition can develop which pulls air into the pump inlet. In a hydraulic system, vortexing is normally the result of low fluid or poor reservoir design.

**6. Release of Air Suspended within the Fluid**

a. There is considerable air suspended in cold hydraulic fluid. As the fluid warms, air is released into the system. A reduction of the fluid pressure will also release air out of suspension.

b. A simple relief valve poppet can create an orifice that increased velocity of the fluid and lowers its pressure. The reduced pressure condition releases air out of suspension into the system.

# Industrial Hydraulic Oil

c. Relief valves should be returned below the fluid level of the reservoir as far from the reservoir outlet as possible. This allows time for the air released by the relief valve to be removed before leaving the reservoir and entering the inlet area of the pump.

**Testing Hydraulic Oil**

The chemical condition of the hydraulic oil can only be determined by a laboratory test. However, a few simple tests may be sufftcient in most cases to determine whether the oil should be changed or re-processed.

1. Feel the oil between the thumb and forefinger for evidence of grit. Another method is to pour a few drops out on a white painted surface and inspect it through a powerful magnifying glass. Grit can be filtered out and this in itself is not an indication that the oil is unfit. Check condition of strainers and replace elements in filters.

2. If the oil is milky this usually indicates emulsification either with air or with water. Draw a sample in a bottle and let it stand for several days to see if water settles out or if the solution clears.

a. If emulsification is caused by water it may be entering from a leak in a shell and tube heat exchanger or may be condensing from the atmosphere. Open the tank drain to see if there is water condensation in the bottom of the tank.

b. If the oil clears without settling out water, this indicates entrained air which may be entering the pump intake due to a loose connection.

3. Draw a small sample in a clear bottle and compare the color with that of a similar sample of new oil of the same kind. The degree of darkening is an indication of the amount of oxidation that has taken place. There is no cause for alarm if the old oil is slightly darker in color but if extreme darkening has taken place, you may want to have a sample analyzed. Your oil company representative may be able to advise you from a visual inspection of your color sample whether you should request an analysis.

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Air Brakes Control Valve | Weekly: Inspect the air supply pressure gauge inside of the HPU. Tolerance: Gauge reads air supply system pressure = acceptable; Gauge reading does not match air supply system pressure = problem. | | Not applicable. | Overhaul by valve manufacturer only. |
| Desiccant Air Breathers | Weekly: Visually inspect the silica gel desiccant. Tolerance: Blue color = acceptable; Pink color = replace. Verify that air intake ports to breather are not plugged. Tolerance: Not plugged = acceptable; Plugged = problem. | When silica gel color changes from blue to pink, replace the desiccant breather. | Replace desiccant breather after 12 months of continuous in-service. | When silica gel color changes from blue to pink, replace the desiccant breather. |
| Hydraulic Oil | Every 6 months: Perform an oil cleanliness test. Tolerance, based upon ISO 4406 Cleanliness Level: 15/12 = normal; 16/13 = minimum. | Following major repairs that require disassembly of piping: Perform an oil cleanliness test. Tolerance, based upon ISO 4406 Cleanliness Level: 15/12 = normal; 16/13 = minimum. | Not applicable. | |
| Hydraulic Pumps | Weekly: Monitor noise level. Tolerance: less than 90 dB = acceptable; Greater than 90 dB = problem. | Low oil pressure. Tolerance: Flow rate greater than 85% of specified rating = acceptable; Flow rate less than 85% of specified rating = problem. | Not applicable. Overhaul by pump manufacturer only. | Noise level greater than 90 dB or flow rate less than 85% of specified rating. Replace pump. Overhaul by pump manufacturer only. |
| | Every 10 years: Check flow rate. Tolerance: Greater than 85% of specified rating = acceptable; Less than 85% of specified rating = problem. | | | |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Hydraulic Pump Unloaders | Monitor pump unloading time. Tolerance: Short duration of unloading cycle = acceptable; Noticeably long pump unloading cycle = problem. | When clogged filter element signal is received, arrange to have the affected element replaced. | None. | Device failure: Determine and correct cause; repair or replace components as applicable. |
| Hydraulic Servomotors | Every 6 months: Visually inspect servo rod for nicks, scratches or excessive buildup of grime and other debris. Tolerance: No nicks, scratches, or buildup of debris = acceptable; Presence of nicks, scratches or debris buildup = problem. | Gate lock cylinder performance. Tolerance: Smooth engagement and disengagement of locking mechanism = acceptable; Erratic engagement or disengagement of gate lock mechanism = problem. | Follow servomotor manufacturer recommendations. | Servomotor or gate lock cylinder failure: Follow servomotor manufacturer recommendations. |
| L&S-400 Distributing Valve | Every 10 years perform a leakage test per L&S Electric specifications and, if possible, compare the test results to tests performed prior to unit commissioning. Tolerance: Test results comparable to commissioning tests = acceptable; Test results showing considerable deviation from commissioning tests = problem. | If distributing valve malfunctions or performs erratically, troubleshoot and correct cause. | Overhaul per assembly specifications provided by L&S Electric, Inc. only when needed. | If distributing valve malfunctions or performs erratically, troubleshoot and correct cause. |
| LVDT (distributing valve) | None. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| MLDT (gates servomotors) | Weekly: Inspect environment at device location for debris buildup. Tolerance: No debris buildup = acceptable; Noticeable buildup of debris = determine and correct source of contamination. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |
| MLDT (gates servomotors) | During unit shutdowns 6 to 12 months after last inspection, remove the protective cover and inspect for debris buildup under cover. Tolerance: No debris buildup = acceptable; Noticeable buildup of debris = determine and correct source of contamination. | Erratic feedback signal. Tolerance: Steady feedback signal = acceptable; Erratic feedback signal = problem. | Not applicable. Overhaul by manufacturer only. | Device failure: Replace. |
| Oil Filter Elements | Weekly: Check visual plugged element indicator. Tolerance: No plugged indication = acceptable; Plugged indication = replace element. | Following major repairs that require disassembly of piping: Tolerance: No plugged indication = acceptable; Plugged indication = replace element. | Replace element(s) after 12 months of continuous in-service. | Upon plugged filter indication, replace element. |
| Pilot Manifold | Refer to oil filter elements information in this chart. | If manifold malfunctions or performs erratically, troubleshoot and correct cause. | Replace the run valve (65-SVR) after 5 years of continuous in-service. | If manifold malfunctions or performs erratically, troubleshoot and correct cause. |
| Speed Sensing Assembly | Unit shutdown. 6 to 12 months after last unit shutdown, remove the PMG cover and inspect the speed sensing components for debris buildup. Tolerance: No debris buildup = acceptable; Noticeable accumulation of debris = determine and correct source of contamination. | Erratic speed signal. Tolerance: Signal is proportional to unit speed = acceptable; Signal is erratic = problem. | None. | If speed signal becomes erratic, inspect the speed sensing circuit as necessary. |

## Recommended Preventive Maintenance Procedures

| Component | Inspection | | Overhaul | |
|---|---|---|---|---|
| | Time Based | Condition Based | Time Based | Condition Based |
| Oil/Nitrogen Accumulators | Weekly: Inspect accumulator system pressure gauge inside of the HPU. Tolerance: Gauge reading within 5 psi of system pressure listed in table on schematic diagram mounted in the HPU door = acceptable; Gauge reading 5 psi greater than or less than value in table = problem. | Accumulator system pressure gauge inside of the HPU begins to flutter suddenly. Tolerance: Steady needle movement within 5 psi of listed system pressure = acceptable; Fluctuating gauge needle = problem. | None. | Upon ruptured nitrogen bladder, overhaul per manufacturer's specifications.. |
| | Every 6 months: Isolate accumulator/gas bottle pairs and check the nitrogen precharge pressure. Tolerance: Pressure reads listed value in schematic diagram inside of HPU door = acceptable; Value reads less than or greater than 5 psi of listed precharge pressure value = problem. | Oil charge time (pump cycle time) becomes unusually short. Tolerance: Charge time duration within normal values = acceptable; Noticeably short time between pump cycles = problem. | | |
| | | Movement of actuators (servomotors) becomes unordinarily slow. Tolerance: Normal actuator stroke speed = acceptable; Noticeably slow actuator stroke speed = problem. | | |
| | | Vibration or noise from oil lines increases abnormally. Tolerance: Oil line vibration or noise within normal levels = acceptable; Noticeably noisy or vibrating oil lines = problem. | | |
| | | Level of hydraulic oil in reservoir ascends or descends abnormally. Tolerance: Steady changes in reservoir oil level = acceptable; Noticeably rapid changes in reservoir oil level = problem. | | |

ENG0196D
IV.F.5-4

# Accumulator Maintenance and Inspection

After unpacking the accumulator bank, inspect it for possible damage caused during transit.

1. Inspect the locknut and the jam nut and bleeder plug for tightness.

2. Check the precharge pressure. The accumulator bank is precharged to a pressure of 25 - 100 psi for shipping purposes.

3. Check that the working pressure stamped on the accumulator is equal to or greater than the maximum pressure of the system.

4. For periodic maintenance, refer to section *Routine Maintenance*, ENG0195 or ENG0956.

## Precharge Checking and Schedule

When an accumulator is installed, the precharge should be checked to ensure that there is no leakage. This should be performed once during the first week of operation, and every six months thereafter. Under high cycling or high temperature conditions, the precharge should be checked once every month.

*NOTE: Check the precharge pressure only after the hydraulic system's pressure has been completely released. Use the system or accumulator drain valve for releasing the pressure in the system.*

## Disassembling and Reassembling the Bladder Accumulator

Refer to the Appendix for a pictorial representation of the disassembly and reassembly of the Bladder Accumulator.

**Disassembly:**

1. Release all the hydraulic system pressure in a safe manner. For this, use the system and accumulator drain valves provided. Remove the accumulator from the system, and place it horizontally, securing it from movement.

*NOTE: It is a good practice to disassemble and reassemble the accumulators in a clean area to keep all parts free of foreign matter.*

# Accumulator Maintenance and Inspection

2. Remove the protective cap on the gas valve, and remove the valve-sealing cap from the valve adapter.

3. Connect a suitable charging and gauging assembly to the valve adapter, and release a11 of the nitrogen precharge pressure from the accumulator until the gauge reads zero.

**4.** Remove the valve adapter from the gas valve body (two piece valve stem design), or remove the valve core if the gas valve body has a core inside (one piece valve stem design).

5. Remove the jam nut and the nameplate from the gas valve body. While removing the jam nut, hold the gas valve body with a wrench so that the bladder will not rotate.

*6.* Remove the bleeder plug from the fluid port. Loosen locknut with a spanner wrench by turning two or three threads, then push the fluid port body into the accumulator shell if there is no hydraulic pressure.

7. Remove the locknut, and then remove the spacer.

8. Push the fluid port body into the shell and remove the backup ring.

9. Slide the anti-extrusion ring off of the fluid port. Carefully fold the anti-extrusion ring until it is sufficiently folded to allow removal from the shell, then remove fluid from the shell.

10. By squeezing the bladder, discharge as much as possible by hand. Then pull the bladder out slowly through the fluid port opening of the shell.

**Reassembly:**

1. Cleaning and inspection.

a. Clean all the metallic components of the accumulator with an organic solvent. Avoid exposing the rubber parts to the solvent to prevent any attack on the rubber.

b. Inspect the condition of the metallic components of the fluid port, and replace the complete fluid port assembly if any part of it is damaged. Push the poppet valve head to make sure it slides freely through the guide in the fluid port.

# Accumulator Maintenance and Inspection

c. Clean the bladder with isopropyl alcohol or equivalent. Inspect the bladder for any visual damages, and replace if necessary.

*NOTE: When ordering parts, furnish model and serial number.*

d. Check that there is no corrosion on the inside or outside of the shell. Replace all parts considered defective.

*NOTE: The O-rings and back up rings* ***must be*** *replaced.*

2. Squeeze the bladder to discharge air from it by rolling it up from the bottom.

3. Install the valve adapter to a torque value of 90 in.lbs. (two piece valve stem design), 01 install the valve core to a torque value of 405 in.lbs. (one-piece valve stem design).

4. Lubricate the accumulator shell and the bladder either with the medium used in the system, or a suitable equivalent. Attach the bladder pull rod to the valve and fold the bladder and pull into the shell. Avoid twisting the bladder while pulling it into the shell.

5. Re-install the nameplate and the jam nut. Do not tighten the jam nut.

6. Insert the fluid port and the anti-extrusion ring into the shell. Slide the anti-extrusion ring over the fluid port. Pull the fluid port through the port opening.

7. Install a charging and gauging assembly on the gas valve, and place a low precharge of 30 psig to seat the fluid port and the anti-extrusion ring into place.

8. Hammer the fluid port body (slightly) at various angles using a plastic hammer.

9. Install the metal back up in the following order: O-ring, rubber backup, and spacer.

10. Tighten the locknut. Install and tighten the bleeder plug.

11. Rotate the accumulator shell around it's axis to lubricate it's inner wall all the way around.

12. Precharge the accumulator the desired pressure at a moderate rate using only DRY NITROGEN. Check the valve for leaks with snoop or soap water.

13. Remove the charging and gauging assembly, install the valve cap and the protective cap. Retighten the assembly locknut and jam nut.

# Routine Maintenance

## Operator Tasks

1. Visual examination of system for damaged or leaking pipes, fittings and components.

2. Visual examination of fluid level in reservoir and fluid condition.

3**.** Check oil temperature. Recommended range is from 100° F **(38'** C) to 110' F **(43'** C).

4. Visual check of operating pressures, filter condition indicators.

5. Cheek guards are in place.

6. Check operation of system.

## Periodic maintenance (weekly or monthly etc., dependent upon operating conditions):

1. Carry out operator tasks.

2. Check pressure readings at test points in system.

3**.** Check pumps for noise level and operating temperature.

4. Check all actuators for damage, noise level, operating temperature, output speeds and forces.

5. Check precharge of any accumulators.

*6.* Check correct operation of any interlocks.

## Annual Maintenance

**1.** Empty fluids reservoir. Check fluid condition.

2. Clean reservoir internally and externally, examine for rust.

**3.** Clean strainers.

4**.** Examine all hoses, pipe work and fittings for damage, wear or leaks. Replace as required.

5. Examine electric motor, clean air passages.

*6.* Examine flexible coupling between pump and motor

# Routine Maintenance

**7.** Check filter elements; replace any which have been in service for twelve months.

8**.** Clean filter bowl.

9. Check filter condition indicators for correct operation.

10. Check leakage of pumps and motors by running under normal conditions and comparing leakage rates with that of new unit or manufacturer's recommendations. If leakage is excessive return to manufacturer for overhaul.

11. Check leakage across piston seals of cylinders, re-seal as required. If replacing cylinder seals obtain a full seal kit from the manufacturer and change all seals.

12. When restarting after a major overhaul follow recommendations for initial starting. It is difficult to lay down a set of checks which will cover all applications. For example, it may be advantageous to carry out pump and motor leakage tests on a more frequent basis.

# Flushing & Cleaning Procedure for Wicket Gate Servo Piping

Oil cleanliness is a very important part of normal operation and it is recommended that a cleanliness procedure be established for oil cleanliness testing. As a minimum, semi-annual testing is suggested. An IS0 4406 cleanliness level of 16/13 should be a minimum allowable operating cleanliness, and the preferred normal should be 15/12 or better.

**When to Flush and Clean Oil Piping:**

**1 .** It is very important on a new installation to follow the below procedure carefully and completely.

2. If major repairs to the turbine require the disassembly of piping, these same procedures should again be followed.

3. If during oil cleanliness testing, any significant contamination is determined, an additional flushing should be considered.

**Procedure:**

1. Make sure pump unloaders have been running in "Hand" mode for a day or that cleanliness of system is at cleanliness of IS0 16/13 or better.

2. Make sure the wicket gate servos are commissioned, then do a "full speed" flushing and cleaning of wicket gate servos. Twenty servo strokes should be used for this process. Suggestion:

a. Do these servo strokes in four groups of five strokes each, with an hour wait between each set group.

b. Keep the pump unloaders running in "Hand" mode at all times during this process.

# Field Piping Connections

1. If running, STOP all pumps; then drain the hydraulic system

2. Monitor the system pressure gauge to ensure that it reads zero pressure (0-psi).

3. Install field tubing and tube fittings as shown on the assembly drawing.

4. Fill the tube lines with filtered hydraulic oil prior to making all final adjustments. This will minimize air entrapment in the system, which is the cause of spongy operation (low bulk modulus).

5. Prior to starting the hydraulic unit, inspect the tubing connections for possible leakage, and tighten any loose connections, if required.

6. If applicable, an air bleed needle valve is provided near each filter of the dual filter assembly. While holding an absorbent cloth around the top of the valve, crack the valve open just enough to allow trapped air to escape, then close the valve.

7. Allow the hydraulic system pressure to build to the required setting, while continuing to monitor for leakage at the tube connections.