Independent Power Plant Operator Technical Training Program

Student Program Outline

Program Outline
Independent Power Plant Operator
Technical Training Program

12 weeks

Days/Times: Monday – Friday, 8.30am – 4.00pm
Pre-requisite(s): Successful completion of the Independent Power Plant Operator Foundation Program

Program Description:

This program is designed to give entry level hydro power plant operators an understanding of the role of hydro-electric power in the overall power system. Students will learn about the characteristics of different types of hydro plants and be introduced to the major components of a typical hydro electric power station. Basic hydraulic principles are also presented as an aid to better understanding of hydro plant operation. The purpose of this course is to present and discuss all of the functions involving the use and control of water in a hydro-electric scheme. The importance of hydrological records is discussed in relation to hydro power plant planning and operation, and reservoir control. Students will understand structural and functional features of different types of hydro turbines and learn about operational considerations, including types of equipment used to monitor and control the operation of the hydro turbine. A review of AC generation fundamentals is also included and students will discuss supervision of the hydro generator including control, monitoring, and protection. Also demonstrated are the main features of auxiliary equipment that form the common elements of auxiliary systems. The objective of this course is to examine, from the operational point of view, the various items of electrical equipment that are commonly installed in the hydro-electric power plant. A brief overview of environmental requirements affecting the operation of the plant is also discussed.

Program Objectives:

Upon successful completion of this program students should be able to:

- Describe the role of the hydroelectric power in the overall power system
- List the major components and describe their use in a typical hydro electric station
- Discuss the functions involving the use and control of water in a hydro-electric scheme
- Describe structural and functional features of different types of hydro turbines
- Describe major constructional features of the hydro generator
- List and describe the types of equipment used to monitor and control the operation of the hydro turbine
- Describe the function and typical layout of the various auxiliary systems which are needed to support the hydro turbine generator

- Describe how to supervise the hydro generator including control, monitoring, and protection
- Examine, from an operational point of view, the various items of electrical equipment that are commonly installed in the hydroelectric power plant
- Demonstrate the general responsibilities and tasks performed by operations and maintenance personnel in a typical hydro plant
- Apply principles of hydro-power plant operations to demonstrate an ability to effectively operate a simulated control panel
- Describe environmental impacts and effects of hydro power generation and construction
- Reporting and documentation
- Understanding drawings
- Field trips to site with operators

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Units 1-12
  - Additional resources/videos/handouts as outlined in Course Schedule

Instructional Techniques:

Videos, lectures, discussion groups, readings, sharing relevant experiences, computer-based inventory and learning, field trips, guest speakers and exams/assignments.

Assignments and Marks	**100%**
Course Quizzes • Please review program outline for quiz dates	30%
Homework, In-Class Assignments & Participation • Participation includes: involvement in group discussions (contribution of ideas, thoughts, comments regarding topic), completion of in-class assignments/exams, attendance and practical requirements (refer to participation and assignment rubric) and attendance	20%
Midpoint Comprehensive Exam	15%
Comprehensive Final Exam:	35%
Final Practical Assessment: • Students must demonstrate competency as outlined in the final practical assessment to pass the program	Pass / Fail

Participation and Assignment Rubric		
Points	**Interpretation**	**Grading Criteria**
18-20	Excellent	Contributions indicate: a) good understanding of the material covered in the course readings and topical resources, b) integration and application of this information to the discussion topic, c) accurate interpretation of the theories/models (and their shortcomings when applicable) that underlie the discussion topic. d) assignments were always completed and were made on time.
16-17.5	Good	Contributions lack at least one of the above criteria but are generally above average in quality. Contributions show evidence of a) thoughtful consideration, reflection and attention to the issues addressed b) adds valuable information to the discussion. c) assignments were generally done and made on time, with late assignments for only one or two sessions.
14-15.5	Average	Contributions lack two of the required criteria but a) show some thought, reflection and attention to the issues and add to the discussion b) assignments may have been late a couple of times with no assignments for one or two sessions.
Less than 14	Below Average	Contributions a) lack thought, reflection, and effort and add little to the discussion. b) assignments were made late most of the time or not done at all.

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 1

Delivery by BCH (BCTC) – some content falls into a more advanced level than required for this course.

Unit 1
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 1: The Hydro-Electric Role in the Power System
Course Description:

The objective of this course, the first in the Hydro-Electric Power Series, is to give students an understanding of the role of hydro-electric power in the overall power system. Students will learn about hydro power fundamentals and the characteristics of different types of hydro plants in relation to their effect on power system operation. An overview of the power system is presented plus a review of the tasks and responsibilities of the power dispatcher and power system operators.

Course Outcomes/Purpose:

Upon successful completion of Unit 1: the Hydro-Electric Role in the Power System of this program students should be able to describe and apply, where applicable, concepts as:

- The characteristics of different types of hydro-electric plant:
  - low head, run-of-the river plant,
  - intermediate head with storage reservoir,
  - High head plant,
  - pumped storage.N/A
- Advantage of interties to neighbouring power systems.
- The power generation mix.
- Characteristics of different types of power generation including fossil, combustion turbines, and nuclear.
- Advantages of hydro power generation.
- The purpose of the transmission system, i.e. to deliver bulk power from the advantages of the integrated power system generating stations to distribution systems.
- The purpose of the distribution system, i.e. to deliver power to all of the individual consumers at the appropriate voltage.

- Comparison of overhead transmission with underground cable. Advanced
- Specific applications where transmission by high voltage DC is advantageous. Advanced.
- Review of equipment installed in typical switching stations, transformer stations, and substations.
- The daily load curve and seasonal load curve.
- The need to have sufficient generating capacity on line at all times of the day to equal the daily load forecast, plus an allowance for fluctuation, plus an allowance for spinning reserve.
- Economic load dispatch. Advanced
- Constraints on economic loading. Advanced
- Prevention of system overload (low frequency).
- The application of the AGC system to control frequency and interchange.Advanced
- Methods of controlling voltage at different points in the system.
- The hydro generator as a synchronous condenser.Advanced
- Power system security.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 1
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 2

Delivery by BCH or Regional – This unit appropriate for this level of training.

Unit 2
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 2: Hydro-Power Stations
Course Description:

The purpose of this unit is to introduce the major components of a typical hydro electric power station. A brief overview of each item of equipment is presented noting that detailed study will be shown in subsequent units in the series. Basic hydraulic principles are also presented as an aid to better understanding of hydro plant operation.

Course Outcomes/Purpose:

Upon successful completion of Unit 2: Hydro-Power Stations of this program students should be able to describe and apply, where applicable, concepts as:

- Factors affecting the power output of a water wheel or hydro turbine, i.e. Q x Hx efficiency.
- The function of dams and spillways.
- Location of the powerhouse.
- Environmental concerns in design and operation of hydro schemes.
- The function of major items of equipment including:
  - intake structure and head works,
  - penstocks, surge tanks, and turbine shut-off valve,
  - impulse and reaction turbines,
  - turbine control system,
  - the rotating element consisting of turbine runner coupled to the generator rotor,
  - thrust bearings, guide bearings, and associated lubricating systems,
  - the generator's exciter, excitation panels, and voltage regulator,
  - the generator stator, cooling radiators, and bus discharge duct,
  - generator step-up transformer, breaker and associated controls,
  - the plant main control room and local control panels.

- auxiliary transformers and auxiliary bus,
- pumps and piping for auxiliary systems, including compressed air, dewatering, and fire protection.
- Example calculations of hydro power output for different conditions, i.e. flow and head.
- These topics may fall into the advanced category:
- The measurement of pressure in American and metric units.
- The effect of head and specific gravity on pressure.
- The distinction between force and pressure.
- The incompressibility of fluids, principle of the hydraulic jack.
- The relationship between potential head, velocity head and pressure head.
- Formation of vacuum due to high velocity flow.
- The need for venting of vessels and piping systems.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 2
  - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 3

Suggest moving to Unit 10 for delivery by Regional Power

Unit 3
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 3: Water Management
Course Description:

The objective for this unit is to present and discuss all of the functions involving the use and control of water in a hydro-electric scheme. The importance of hydrological records is discussed in relation to hydro power plant planning and operation, and reservoir control. After completion of this unit the participant should be able to understand the following concepts and apply them in day-to-day activities.

Course Outcomes/Purpose:

Upon successful completion of Unit 3: Water Management of this program students should be able to describe and apply, where applicable, concepts as:

- Requirements for sitting a hydro-electric power plant. Setting?
- Water flow in the catchment area (water shed, drainage basin).
- Elevation (available head) at potential sites.
- Study of hydrological data:
  - daily average flows,
  - monthly average flows,
  - annual average flows,
  - flash flood flows,
  - cyclical variations, i.e. 12 year drought pattern.
- The relationship between generator size, seasonal variation in flow, and capacity factor.
- Application of the duration curve in sizing hydro plant generators. (Advanced?)
- Construction of dams.
- Features of different types of dam:
  - the gravity dam,
  - the embankment dam (earthfill, rockfill),

- the concrete arch type dam,
- the concrete buttress type dam.
- Forces trying to destroy the dam.
- Monitoring dam performance, i.e. leakage, stability.
- Function and location of spillways.
- Spillway capacity.
- Spillway construction.
- The uncontrolled overflow spillway.
- Spillway gates.
- Skimmer gates.
- Forebay construction.
- The intake structure including trash racks, stop logs, intake gates and air vents.
- The function of bubblers in cold climates.
- Water conveyances, canals, flumes.
- Cascade arrangement of power plants.
- Reservoir control parameters.
- Aids to water management (water dispatch):
  - reservoir storage curve,
  - anticipated inflows for the coming weeks and months,
  - anticipated generation and outflows,
  - predicted reservoir draw down curve. (this content may be considered advanced and is already taken into consideration by the control engineers)

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 3
- Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 4

Delivery by Industry representatives ie: Dependable Turbines, Alstom, Canadian Hydro etc…

Some content may be considered advanced for this level except for covering turbine types for the region.

Unit 4
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 4: Hydro Turbines
Course Description:

The objective of this unit is to present and discuss the structural and functional features of different types of hydro turbines. Certain operational considerations are also presented such as cavitations, tailrace elevation, surge, run away speed, etc.

Course Outcomes/Purpose:

Upon successful completion of Unit 4: Hydro Turbines of this program students should be able to describe and apply, where applicable, concepts as:

- Impulse and reaction type turbines.
- The Pelton wheel, vertical and horizontal.
- Single and multiple nozzle arrangements.
- Needle valve control and deflectors.
- Turbine shut-off valves.
- Propeller type turbines, vertical and horizontal.
- Fixed and variable pitch blades (Kaplan).
- Function of the draft tube.
- Wicket gates, shear pins, lubrication.
- Turbine guide bearing.
- Francis type turbine, vertical and horizontal.
- Hydraulic thrust, head cover leakage.
- Tube type turbines.
- Bulb type turbines.
- Deriaz type turbines.
- Comparative turbine efficiencies.

- Turbine generator overspeed due to load rejection.
- Pressure surges due to load variation (and rejection).
- The function of surge vessels.
- Cavitations - causes and effects.

The influence of tailrace elevation.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 4
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 5

Delivery by Industry representatives: ie; Sequoia Engineering, ABB, Schneider
Many of the topics would be considered advanced, but some are essential for this level.

Unit 5
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 5: Turbine Monitoring and Control
Course Description:

The objective of this unit is to present and discuss types of equipment used to monitor and control the operation of the hydro turbine. Typical examples of mechanical hydraulic and electro hydraulic actuators are demonstrated plus monitoring and protection devices.

Course Outcomes/Purpose:

Upon successful completion of Unit 5: Turbine Monitoring and Control of this program students should be able to describe and apply, where applicable, concepts as:

- The need for turbine controls, monitoring systems, alarm and annunciators, and protection devices.
- Methods for controlling the flow of water through the turbine.
- The effect of control action before the generator is synchronized, and after the generator is synchronized.
- Operation of the mechanical hydraulic actuator for control of wicket gates.
- Force amplification through the servo mechanism. Advanced
- The need for reset action to stabilize actuator operation. Advanced
- Operation of the hydraulic oil system, including pressurized oil tank, oil pumps, and compressors.
- Automatic governor operations using the "flyball" type governor head. Advanced
- The purpose of the PMG, "Permanent Magnet Generator". Advanced
- The function of the governor speeder set point control, i.e. speed or load adjustment. Advanced
- Response of the turbine governor to frequency (speed) changes.
- The function of the speed droop characteristic, i.e. sharing of load changes between generators in parallel. Advanced
- The effect of changes in speed droop setting. Advanced
- The function of the gate limiter.

- The use of the gate limiter for manual control during start-up or power output control.
- The function of reset signal damping, i.e. the dash pot in older machines. Advanced
- Requirements for monitoring turbine conditions, i.e. critical measuring points.
- The implications of high bearing temperatures, excessive vibration, and shaft misalignment.
- Abnormal turbine conditions which necessitate shutdown of the unit, i.e. overspeed.
- The turbine generator trip (shut-down) circuit.
- Types of overspeed trip devices.
- Operation of the electro hydraulic actuator and governor system.
- Operation of the electronic SSG (Speed Signal Generator) in place of the PMG. Advanced
- The nature of digital control systems versus analog.
- Pre-programming turbine operations through microprocessor control.
- Using the SCADA system for remote operation from the energy control centre.
- Monitoring and control of the turbine through the operator CRT interface in the powerhouse.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 5
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 6

Delivery by Industry representatives: GE, Alsthom, Toshiba etc…

Unit 6
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 6: The Hydro Generator
Course Description:

The objective of this videotape is to present and discuss the major constructional features of the hydro generator. A review of AC generation fundamentals is also included, as this is considered necessary for complete understanding.

Course Outcomes/Purpose:

Upon successful completion of Unit 6: The Hydro Generator of this program students should be able to describe and apply, where applicable, concepts as:

- Constructional features of the vertical generator.
- Function of the stator frame, stator iron core, and core laminations.
- Stator windings and stator conductor arrangements.
- Constructional features of the rotor.
- Rotor poles, excitation current, and slip rings.
- Thrust bearing arrangements, using tilting or spring-loaded pads.
- Generator guide bearings.
- Lube oil cooling.
- High-pressure oil jacking system.
- Protecting bearings against stray eddy currents, i.e. bearing insulation and shaft grounding. Advanced
- The function and operation of the braking system.
- Sources of heat loss in the generator.
- Generator air-cooling system.
- Stator conductor cooling water system.
- Generator terminal equipment, i.e. generator terminals, isolated phase bus, PT's and CTs. Advanced
- Constructional features of the horizontal generator.
- Review of AC generation fundamentals.

- Production of the voltage sine wave due to the rotating magnetic field.
- RMS values of voltage and current. Advanced
- The relationship between frequency, speed of rotation, and number of poles.
- Three phase windings and connections. Advanced
- Neutral grounding through resistance and/or grounding transformer. Advanced
- Voltage relationships for the Wye connection. Advanced
- Types of excitation systems:
  - static excitation,
  - brushless exciter,
  - externally driven exciter,
  - the traditional shaft mounted main and pilot exciter.
- Control of excitation.
- The conditions required for synchronizing the generator to the power system.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 6
  - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 7

(Advanced) Industry representatives: Sequoia, Schneider etc…

Unit 7
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 7: Generator Monitoring and Control
Course Description:

The objective of this module is to present and discuss supervision of the hydro generator including control, monitoring, and protection. Included is a review of the significance of active and reactive power output from the generator.

Course Outcomes/Purpose:

Upon successful completion of Unit 7: Generator Monitoring and Control of this program students should be able to describe and apply, where applicable, concepts as:

- Control of active (megawatt) and reactive (megavar) power output from the generator. Advanced
- The significance of megawatt, megavar, megavolt amps, and powerfactor. Advanced
- Governor control of power output. Advanced
- AVR control of excitation with consequent control over terminal voltage and reactive power output. Advanced
- The significance of load angle (power angle) in determining the power outputs of generators, which are synchronized together on the same system. Advanced
- The limits of generator operation as indicated by the generator capability curve. Advanced
- The arrangement of the traditional operators' control panel for the hydro generator, including indicating instruments, recorders, alarms and annunciators.
- Calculation of generator MVA output from indicating instruments such as terminal voltage, and stator current. Advanced
- The function of energy integrating meters, i.e. MWH and MVARH. Advanced
- Sensing points for monitoring the physical condition of the generator.
- Operation of alarms and annunciators.
- Digital control systems; the operator CRT interface.
- Monitoring and control of remote plants through the SCADA system.

- Information printouts, trends, log.
- Information transfer to the energy control centre and other company departments.
- The need for generator protection; the nature of generator internal faults.

The application of protective relays, and resultant tripping action.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 7
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 8

Industry representatives: Stealth Valve (Martin Korsch, Halfmoon Bay), Sealweld etc…

Unit 8
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 8: Hydro Plant Auxiliaries
Course Description:

The objective of this unit is to present and discuss the function and typical layout of the various auxiliary systems which are needed to support operation of the hydro turbine generator. Also demonstrated are the main features of auxiliary equipment that form the common elements of auxiliary systems.

Course Outcomes/Purpose:

Upon successful completion of Unit 8: Hydro Plant Auxiliaries of this program students should be able to describe and apply, where applicable, concepts as:

- The function and application of different types of valves, including the gate valve, the globe valve, the control valve, the butterfly valve, the spherical ball valve, bypass valves, check valves, and the pressure relief valve.
- The operation of vents and drains on piping systems and equipment.
- The effect of water hammer.
- The function and application of centrifugal pumps, both horizontal and vertical.
- The function and application of positive displacement pumps, including the reciprocating pump, the screw type pump, and the gear pump.
- The function and application of compressors, including compressor cooling and water extraction from compressed air.
- Strainers and filters.
- The importance of correct lubrication on all types of equipment.
- Typical raw water and service water systems.
- Features of cooling water systems.
- Dewatering and drainage systems.
- The supply of high-pressure water for fire protection systems, including sprinkler deluge systems.

- Other fire protection systems, i.e. CO2 or Halon.
- Compressed air systems, including service air, instrument air, high-pressure governor accumulator air, and blowdown air for synchronous generator operation.
- Oil storage and cleaning systems.

Ventilation systems for the powerhouse.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 8
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 9

(Advanced) Industry representatives: BCTC, Schneider, ABB etc…

The majority of this Unit is beyond the requirements at this level. Alternatively, a brief overview of the topics should be discussed including; devices, function and observation for abnormalities. The student should be aware of the devices and function but not be able to take any actions regarding them except under the strict supervision of qualified professionals.

Unit 9
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 9: Operating Electrical Equipment
Course Description:

The objective of this unit is to examine, from the operational point of view, the various items of electrical equipment that are commonly installed in the hydro-electric power plant. The unit looks at switchyard equipment, station service supply, DC power supply, and uninterruptible AC power supply. Safety of personnel and equipment is also discussed.

Course Outcomes/Purpose:

Upon successful completion of Unit 9: Operating Electrical Equipment of this program students should be able to describe and apply, where applicable, concepts as:

- Reading one-line diagrams and schematics.
- Generator circuit breaker arrangements
  - at generator voltage,
  - on the high voltage side of the directly connected generator step-up transformer.
- Features of transformers including:
  - terminal connections,
  - grounding,
  - cooling arrangements,
  - transformer protection devices,
  - the significance of transformer gassing,
  - nitrogen sealing.
- The function and characteristics of switchyard equipment including:
  - disconnects,
  - grounding disconnects,
  - lightning arresters,
  - potential transformers - PTs.

- The application of high voltage cables.
- The function of circuit breakers including arc extinction by oil, air blast, SF6, vacuum, and blowout coils.
- The function of the switchyard bus.
- Bus arrangements.
- Station service supply.
- Black start capability.
- Plant auxiliary power board layout.
- Auxiliary power for remote locations, i.e. spillway and control structures.
- Circuit breakers and motor contractors for operation of plant auxiliaries.
- The characteristics of breakers and contractors on loss of power supply, i.e. to remain closed or to open.
- The application of DC power for emergency lighting, emergency equipment, control, alarm and protection circuits.
- DC power supply sources.
- Critical AC circuits, including communications, computer equipment, protection and control
- circuits.
- The provision of uninterruptible AC for critical circuits.
- The importance of equipment safety and personal safety in connection with high voltage electrical equipment.
- The application of operating procedures to avoid equipment damage due to faulty operation.
- The application of clearance procedures to ensure personnel safety when performing maintenance.
- The responsibility of each individual to ensure his own personal safety when working around electrical equipment in the plant.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 9
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 10

Regional Power delivery

Unit should also include working with contractors during Inspection & Maintenance including safety. Conducting tours of the facility by the public or others should also be a topic for discussion.

Unit 10
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 10: Hydro Plant Operation and Maintenance
Course Description:

The objective of this unit is to review and demonstrate the general responsibilities and tasks performed by operations and maintenance personnel in a typical hydro plant. It thus brings together many of the items discussed in earlier units. Included is a brief overview of environmental requirements affecting the operation of the plant.

Course Outcomes/Purpose:

Upon successful completion of Unit 10: Hydro Plant Operation and Maintenance of this program students should be able to describe and apply, where applicable, concepts as:

- Operating personnel for different types of plant.
- General responsibilities of the operator.
- Safety of equipment and personnel.
- Clearance procedures.
- Equipment status (availability).
- Routine inspection of operating equipment.
- Logging and reporting; Conditions, incidents, defects.
- The importance of good housekeeping.
- Operating routines i.e. start-up, shutdown, synchronous condenser operation, dewatering, etc.
- Factors that impose limits on operation.
- Operation of intakes and control structures.
- Ecological factors.
- Fish ladders and lifts, effects of variation in water level, dissolved oxygen content.
- The importance of long range maintenance planning.
- Breakdown maintenance, running maintenance, preventive maintenance, predictive maintenance.

- Equipment inspection programs, daily, monthly, annual and overhaul.
- Maintenance job procedures (work guides).
- Maintenance records.
- Condition monitoring.

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 10
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 11

Delivery by Sechelt Indian Band (Sid Quinn)
Field trip to Sechelt Creek.

Unit 11
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 11: Environmental Considerations
Course Description:

The environmental considerations unit will prepare operators for the various aspects associated with hydro generation and its impact on the environment. Topics will include sediment and erosion control, vegetation and site reclamation monitoring, spill and fire response and debris management. Operators will learn about regulatory requirements and operational regulator responsibilities, as well as mitigation strategies. Water diversion will also be covered.

Course Outcomes/Purpose:

Upon successful completion of Unit 11: Environmental Considerations of this program students should be able to describe and apply, where applicable, concepts as:

- TBA

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 11
    - Additional resources/videos/handouts as outlined in Course Schedule

Technical Training Program
Independent Power Plant Operator

Student Course Outline
Unit 12

Regional Power delivery

Unit 12
Course Outline
Independent Power Plant Operator
Technical Training Program

Days/Times: Monday – Friday, 8.30am – 4.00pm

Unit 12: Sechelt Technical Training – Simulator Application
Course Description:

The objective of this course, the final in the Hydro-Electric Power Series, is to give students an opportunity to apply the principles learned in Units 1-10 in a simulated classroom. Students will practice controls and apply safety principles when operating the simulator. This unit serves as an opportunity to integrate knowledge from previous units.

Course Outcomes/Purpose:

Upon successful completion of Unit 11: Sechelt Technical Training of this program students should be able to describe and apply, where applicable, concepts as:

- Describe process and procedures of general plant operations including
  - Performance
  - Turbine Speed
- Describe process and procedures of generator operations
- Describe process and procedures of hydroelectric plant operations including
  - Synchronization
  - Power fluctuation
  - Overspeed
- Describe the processes for operating hydroelectric plant and the required operator verifications to be done before start-up
- Describe process and procedures when conducting start-up and operation procedures
  - operation modes
  - start-up sequences
- Describe process and procedures when conducting shut down procedures
  - shut down sequence
  - dewatering of penstock Advanced
- Describe equipment control procedures and demonstrate an ability to perform as required the following:

- Ball valve and bypass valve control
- Jets position selector
- Water level controller operation
- Deflectors

- Describe and demonstrate an ability to perform unit start procedures including:
  - Auto operation mode start – level loading
  - Auto operation mode start – position loading
  - Manual operation mode start
  - Test operation mode start – with water
  - Test operation mode start – without water
- Describe and demonstrate an ability to perform unit stop procedures including:
  - Normal stop
  - Emergency Level I Shutdown Stop
  - Emergency Level II Shutdown Stop
- Describe and demonstrate an ability to perform troubleshooting procedures including:
  - Alarm annunciation
  - Common alarm condition troubleshooting
  - Re-energising the plant following a line trip
  - Unit alarm condition troubleshooting
  - Starting of unit following a unit trip

Course Text and Materials:

- VanAsep Student Manual: IPPO Technical Training Program Unit 11
  - Additional resources/videos/handouts as outlined in Course Schedule

Independent Power Plant Operator
Technical Training Program

Program Schedule

VanAsep
INDEPENDENT POWER PLANT OPERATOR – TECHNICAL TRAINING PROGRAM
PROGRAM SCHEDULE

(Subject to change at the Instructor's Discretion)

DAY	TOPICS	STUDENT HANDOUTS & RESOURCES	ASSIGNMENTS & EXAMS
	UNIT A **INTRODUCTION & ORIENTATION**		
1	Hydro Power In Canada Hydro Power Facilities Green Hydro Power	Student Manual Unit A 1. Hydro Power in Canada 2. Hydro Power Facilities Fact Sheet	
2	Run-of-the-River Plants Terminology Review Green Power Clean Hydro	Student Manual Unit A 1. Run-of-the-River Plants 2. Glossary of Terms	
	UNIT 1 **THE HYDRO ELECTRIC ROLE IN THE POWER SYSTEM**		
3	Segment A: Characteristics of Hydro-electric Plants Segment B: The Power System Segment C: Transmission and Distribution	Student Manual Unit 1 1. HPPO Student Workbook Unit 1 2. Green Hydro	
4	Segment D: Power Dispatch Segment E: Power System Operation		
5	**Unit 1 Quiz** Green Hydro Power		**UNIT 1 QUIZ**
	UNIT 2 **HYDRO POWER STATIONS**		
6	Segment A: Power From Water Segment B: Major Components and Systems Segment C: Hydraulic Principles I	Student Manual Unit 2 1. HPPO Student Workbook Unit 2 2. Hydro Power Doesn't Count as Clean Hydro	
7	Segment D: Hydraulic Principles II		
8	**Unit 2 Quiz** Hydro Power Doesn't Count as Green Energy: Debate		**UNIT 2 QUIZ**

Comments were added with the understanding that the purpose of the program is to produce an individual who would be a desirable candidate for selection to

attain an entry-level position at an IPP hydroelectric facility. Such a candidate would be proficient at identifying and understanding the function of the various components found at a typical hydroelectric IPP facility in British Columbia. The individual would be able to demonstrate knowledge of the basic principals of the start-up sequence and understand some basic common issues that may prevent the safe start-up and connection to the grid. Safe response to common trip conditions and the appropriate corrective actions would also be demonstrated. The program should emphasize safety for the individual, the public, the environment and the facility itself.

A further level(s)might be considered for those individuals already working in the IPP industry who might wish to advance their skillset and knowledge level.

LEVEL 1

To Learn By Doing

Basic Theory of Electricity and Electromagnetism

Through the use of models and experiments, the student should be able to demonstrate a basic understanding of the principles of electricity and electromagnetism.

An understanding of conductors, dielectrics, magnetic lines of force, direct current, alternating current, storage batteries etc… will be demonstrated.

Physics of Hydraulic Force

The principles of hydraulic force, head, pressure, potential energy.

Penstock construction, air release valves

Construct a working model hydroelectric generator

Using materials provided, the student will construct a simple turbine that turns when a hydraulic force is applied.

Using materials provided, the student will construct a simple generator.

Connecting the turbine and generator, the student will use a hydraulic force to light a small lamp.

Site Visits

Safety

Vehicles and travel

What to do:

- Output check – head X flow = output

What to look for:

- Leaks

- Unusual noises/vibrations
- odours

Identifying risks:

- Problem trees
- Road issues
- Leaks
- Heating in motors/bearings

Proactive response

Working alone

Communication devices

Contractors/Technicians

Lockout/Tagout

PIC responsibilities

Tailboard safety meetings

Communicating with the Utility

Terminology

Protocol

Identification of switches

Reading a single line diagram

Lockout points

Documentation

The student will demonstrate the ability to construct and send a report of each of the following types:

- Outage Report
- Production Report
- Site Visit Report
- Incident Report including picture attachment

Outage Response

What to do

Evaluating the situation

Recording current situation

Steps to restart

When to request assistance

Emergency Response

On call responsibilities

Personal safety

Property Safety

Environmental safety

Public safety

Appropriate notification to emergency teams

Appropriate notification to supervisor

Predator awareness

Maintenance

Trashrack cleaning

Reading the manuals – finding information

Basic mechanical maintenance compressors, hydraulic pressure units, valves, motors, gensets.

Site vehicle maintenance

Power tool maintenance

HVAC maintenance

Cleaning

Fundamentals of lubrication

House/Groundskeeping

Use of power tools

Tree felling

Lawns and gardens

Cleaning in a powerhouse – safe and unsafe conditions

Storage, Handling and Disposal of chemicals

Site Visits

Safety

politics

environmental knowledge

site knowledge