

Canadian Power Industry Course

Table of Contents

1.	Basic Concepts	1
	What is Electricity.....	2
	Uses of Electricity.....	3
	AC Frequency	4
	Three Phase	5
	Transmission Voltages - AC vs DC.....	6
	Transmission Voltages can't	7
	Supply and Demand Must Balance.....	8
	Electricity Cannot be Stored.....	9
	Conservation of Energy.....	10
	Kirchoff's First Law.....	11
	Electric Power Systems	12
	How is Electricity Measured	13
	Power Units of Measurement.....	14
	System Load Profile.....	15
2.	Generation Basics.....	1
	Components of Generation	2
	Generating Electricity	3
	Generator Animation	4
	How Electricity is Generated	5
	Heat Rate.....	6
	Typical Plant Economics.....	7
	Characteristics of Generation Technologies	8
3.	Coal Plants	1
	Coal Fired Generation	2
	Coal Plant Animation	3
	Coal Fired Plant	4
	Coal Plant Video	5
	Keephills Coal Plant.....	6
	Genesee Coal Plant.....	7
	Drum Boiler Water Circulation	8
	Boiler.....	9
	Supercritical Steam	10
	Description of a Steam Turbine	11
	Turbine Cutaway View	12
4.	Gas Fired Plants.....	1
	Simple Cycle Generation	2

Simple Cycle Power Plant.....	3
LM6000 Gas Turbine	4
GE 7FB Gas Turbine	5
Industrial Gas Turbine (GE 9FA Class).....	6
Cogeneration	7
Combined Cycle.....	8
Combined Cycle Power Plant	9
Natural Gas Fired Plant Video	10
Thermal Efficiency for Combined Cycle.....	11
3 Unit Combined Cycle Plant	12
Steam Turbine and Generator	13
Single Pressure HRSG	14
Duct Firing	15
Combined Cycle – Duct Fired	16
5. Renewables	1
Wind Generator.....	2
Winder Generator Cutaway	3
Wind Farm Video	4
Wind Project Characteristics.....	5
Wind Project Incentives	6
Wind Technical Issues	7
Capacity Duration Curve for Wind.....	8
Hydro Power Plant	9
Hydro Turbine Generator	10
Hydro Plant Animation	11
Hydro Generator Animation	12
Small Run of River Hydro.....	13
Run of River – Manitoba Hydro, Kettle.....	14
Reservoir – Hoover Dam.....	15
Biomass Technical Issues.....	16
Green Tax Incentives	17
Class 43.2	18
6. Nuclear	1
Fission.....	2
Uranium	3
Moderation of Neutron Speed	4
Basic Types of Reactors	5
Pressurized Water Reactor (PWR).....	6
PWR Schematic.....	7
CANDU Reactor.....	8
CANDU	9
CANDU Safety	10
Darlington Nuclear Facility – Ontario.....	11
7. Clean Coal Technologies	1

	Oxy Fuel Coal Plant	2
	Oxy-Fuel Combustion.....	3
	Amine Scrubbing Coal Plant	4
	Gasification for Hydrogen Production 1)	5
	Gasification for Hydrogen Production 2)	6
	Gasification for Hydrogen Production 3)	7
	Gasification for Power Production 1).....	8
	Gasification for Power Production 2).....	9
	Gasification for Power Production 3).....	10
	Carbon Dioxide Storage	11
8.	Transmission	1
	What is Transmission.....	2
	Transmission System.....	3
	Transmission Support Structures	4
	Transmission Support Structures con't	5
	Double Circuit Transmission Line.....	6
	Transmission Losses	7
	Substation	8
	Transformer.....	9
	Typical Substation Transformer	10
	Transmission System Planning	11
	System Planning Criteria.....	12
	Transmission Costs.....	13
	Transmission Tariff.....	14
	Alberta's Transmission Cost Recovery.....	15
9.	Distribution	1
	What is Distribution	2
	Distribution	3
	Distribution Transformer Pole.....	4
10.	Canadian Power Markets	1
	Four Types of Markets	2
	A) Regulated Market	3
	Regulated Market Description	4
	B) Single Buyer Market	5
	Single Buyer Description	6
	C) Wholesale Market.....	7
	Wholesale Market Description	8
	D) Retail Market	9
	Retail Market Description	10
	E) Retail Market – Bilateral Trading	11
	Bilateral Market	12
	Alberta Market.....	13
	Industry Structure (June 2003).....	14
	Alberta's Spot Market.....	15

Features of Alberta’s Market	16
Alberta’s Bilateral Market	17
Ontario Market	18
Reorganization of Ontario Hydro (1999)	19
Ontario Power Authority (2004)	20
Ontario Market Structure	21
Prices in IESO Market	22
Offer Transaction Timeline	23
Congestion Pricing in Ontario	24
Operating Reserves in Ontario	25
Market Surveillance Panel (MSP)	26
Money Flow In Ontario Market	27
Ontario Generation Supply	28
BC Market	29
BC’s Power Market.....	30
Features of BC Market	31
Manitoba Market	32
Manitoba’s Power Market.....	33
Features of Manitoba’s Market.....	34
Saskatchewan Market	35
Saskatchewan’s Power Market	36
Features of Saskatchewan’s Market	37
11. Pricing and Rates.....	1
Electricity Rates.....	2
Four Ways to Buy Power	3
1) Regulated Rates	4
Revenue Requirement	5
Cost of Service Process	6
Determination of Rates	7
Rate Structures	8
Typical Residential Bill Components	9
BC Hydro Residential Bill	10
Regulated Retail Rates - Alberta	11
Wires Owners - Alberta	12
Flow-through RRT - Alberta	13
Alberta’s Regulated Retail Rate	14
Typical Residential Bill - Alberta.....	15
Riders	16
Retail Rate – Ontario.....	17
Two Types of Meters.....	18
How to Read an Electromechanical Meter	19
Typical Time of Use Meter Measurements	20
Ontario Time-of-use Meter Rates.....	21
2) Competitive Offer	22
Alberta’s Retail Market	23
Alberta Retailers.....	24
Responsibility of Retailers.....	25

Self-Retailers	26
Retail Restructuring: ENMAX Example	27
3) Purchases from the Pool	28
How Spot Price is Determined (1)	29
How Spot Price is Determined (2)	30
How Spot Price is Determined (3)	31
Prices Change as Load Changes	32
Market Heat Rate	33
4) Purchase from a Marketer	34
Physical Bilateral Contract	35
Financial Bilateral Contracts – CFD	36
How a Monthly Bill is Determined	37
Types of Settlement	38

To Be Reviewed if Time Permits

12. System Operations	1
System Control Parameters	2
System Control Mechanism	3
Reserve Margin	4
System Operating Constraints	5
Continued	6
Generation Operating Constraints	7
System Operation	8
Ancillary Services	9
Types of Ancillary Services	10
Operating Reserves	11
Three Types of Operating Reserves	12
13. Electricity and the Environment	1
GHG Emission in Canada	2
Canadian GHG Emissions	3
Characteristics of Generation Technology	4
Comparison of Environmental Impacts	5
CO ₂ Emissions by Generation Type	6
Typical Plant Emissions	7
SO ₂ Emissions in Canada in 2000	8
NO _x Emissions in Canada in 2000	9
Mercury Emissions in Canada in 2003	10
Environment Initiatives	11
BC Initiatives	12
Alberta Initiatives	13
Ontario Initiatives	14
Federal GHG Plan	15
Technology Fund	16
Emissions Trading	17
Air Pollution Emissions	18

14. Regulation.....	1
Why is there Regulation?	2
What is Regulated in the Industry?	3
How Does the EUB Regulate?	4
Contents of an Application	5
EUB Decision Making Process	6
Hearing Process.....	7
Hearing Process.....	8
Types of Hearings	9

CONVERSIONS	Blue sheets
ACRONYMS AND GLOSSARY	Green sheets