

Quality Guidelines for
Western Canadian Condensate

speaker:

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- 21 years in Process Engineering, Refining, Planning, Product Supply, Crude Trading, Upgrading
- Current chair CAPP Crude Oil Quality Committee
- Active Chair (TAN) and participant within CCQTA projects
- Active member of COQG

acknowledgement to CAPP Crude Oil Quality Committee members

Thanks for Information gathered from

Paul Unruh / Barry Lynch (CAPP)

Bill Lywood (Crude Monitor Inc)

- **Introduction to...**
 - Enbridge Condensate Stream (CRW)
- **Touchpoints on CRW supply**
 - Historical recap, Present operation, Future growth
- **Specification/Quality Management**
 - Role of CAPP's Crude Oil Quality Committee
 - Future quality management

- Enbridge managed condensate stream
- referred to as **CRW** ; sourced at Edmonton
- An equalized pool (gravity, sulphur, butane)
- currently consist of several main supply sources from Western Canadian Sedimentary Basin
 - Field condensates
 - Ultra light crude sweet crudes
 - Refinery and Upgrader naphtha streams
 - Pipeline delivered in batch or semi continuous basis
- **Current volume nominally 100 kbpd**
- **Traded commodity on NetThruput**

Example of May 2008 CRW Enbridge Equalization (EQ) data



Commodity (Facility)	Other Name/Pipeline	C1	C2	C3	IC4	NC4	IC5	NC5	C6+	Sulphur (%)
CAM (BPCECFTSAS)	Amoco/BP Energy	0.08	0.00	0.10	0.38	2.68	13.61	18.49	64.66	0.02
CBG (BGLENPL)	Bonnie Glen	0.06	0.01	0.14	0.36	4.26	14.99	16.73	63.45	0.24
CFD (PMBINANRTH)	Pembina North	0.08	0.13	0.28	0.57	3.52	10.83	18.41	66.19	0.06
CFT (FTSASKPL)	Fort Sask Pipeline	0.06	0.01	0.09	0.18	3.51	22.70	27.01	46.44	0.02
CGB (GIBPLEDPL)	Gibson Petroleum Co	0.07	0.07	0.74	1.16	5.37	12.29	14.97	65.33	0.22
CPC(PETCNEEDPL)	Petro-Canada Refinery	0.09	0.00	0.00	0.08	1.48	11.75	20.22	66.39	0.00
CPM (PEMBINAPL)	Pembina Pipeline	0.07	0.10	0.74	1.38	4.86	6.97	9.98	75.91	0.26
CPR (PEACEPL)	Peace Pipeline	0.07	0.11	1.00	0.79	4.55	7.70	12.01	73.77	0.12
CRB (RAINBOWPL)	Rainbow Pipeline	0.09	0.08	0.89	0.71	5.63	10.60	16.98	65.03	0.10
CRM (RIMBEYPL)	Rimbey Pipeline	0.05	0.01	0.14	0.41	4.58	16.72	19.72	58.36	0.03
OSN (SUNCORPL)	Suncor	0.08	0.00	0.07	0.80	6.48	4.56	10.60	77.41	0.01
CRW (CLPLWDIL)		0.06	0.05	0.41	0.64	4.14	13.28	17.64	63.77	0.13

May-08 Pipeline	Weighted Average Density kg/m3	m3	bbl	kbpd
Amoco (CAM)	704.0	15530	97683	3.2
Bonnie Glen (CBG)	713.4	7019	44147	1.4
Federated Pipe Line (CFD)	712.5	4138	26028	0.8
Fort Sask Pipe Line (CFT)	670.9	85955	540642	17.4
Gibson Petroleum Co. (CGB)	755.6	66275	416858	13.4
Peace Pipe Line (CPR)	735.1	82008	515814	16.6
Pembina Pipeline (CPM)	765.3	97182	611254	19.7
Petro Canada Refinery (CPC)	689.3	32913	207014	6.7
Rainbow Pipeline (CRB)	748.7	2207	13883	0.4
Rimbey Pipeline (CRM)	699.8	56617	356107	11.5
Suncor (OSN)	726.0	13983	87953	2.8
Total for Enbridge (CRW)	723.1	463827	2917383	94.1

produced monthly by Enbridge

For Additional historical quality information see www.crudemonitor.ca

- **Historically this stream was valued as a (neat) condensate crude commodity to downstream Refiners. Supply economics have shifted this commodity to be primarily used a diluent for Canadian Heavy Crude.**
- **Bitumen and Heavy Crude Oil must be diluted to meet pipeline viscosity and density specifications. Two blend type conventions**
 - **upgraded light synthetic blends (SYNBIT, ~50/50 ratio) or**
 - **heavy and bitumen diluted with condensate (DILBIT, ~25/75 ratio)**
- **Companies manage this diluent need within their own supply sources/facilities or purchase CRW for diluent needs.**

In the end CRW is a common Diluent used in many DILBITS.

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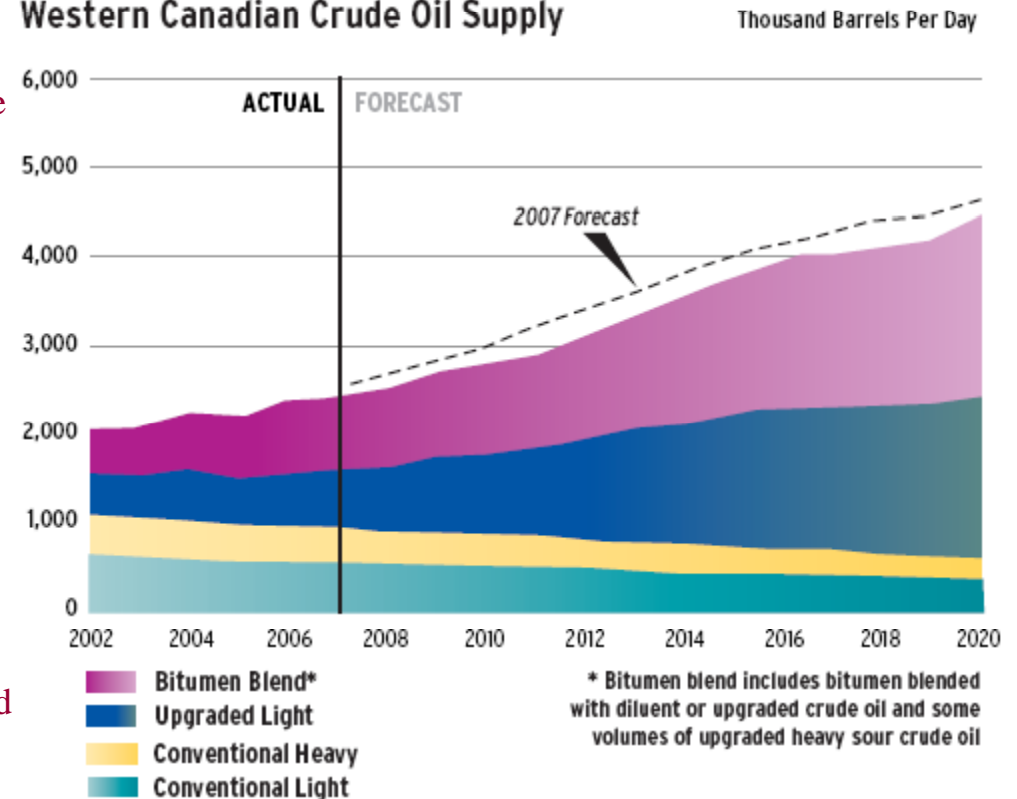
Western Canadian Condensate - Supply



Current and forecasted supplies of gas condensate produced in the Western Canadian Sedimentary Basin (WCSB) are in the order of 150,000 b/d (25,000 m³/d) until 2015. This quantity of condensate is insufficient to provide diluent for the predicted growth in heavy crude and bitumen blend production in the same time frame. Alternatives to gas condensate have been, and will continue to be, tested and used as diluent alternatives. It has been estimated that diluent imports in the order of 150,000 b/d to 200,000 b/d will be required in the future.

Locally produced condensate is no longer sufficient and, in fact, companies have imported up to 50,000 b/d of diluent into Alberta by rail in 2007. To meet growing diluent demand, Enbridge is planning to construct the Southern Lights diluent pipeline from Chicago to Alberta. It is expected to be in service in July 2010, and will have the potential to supply up to 180,000 b/d of diluent.

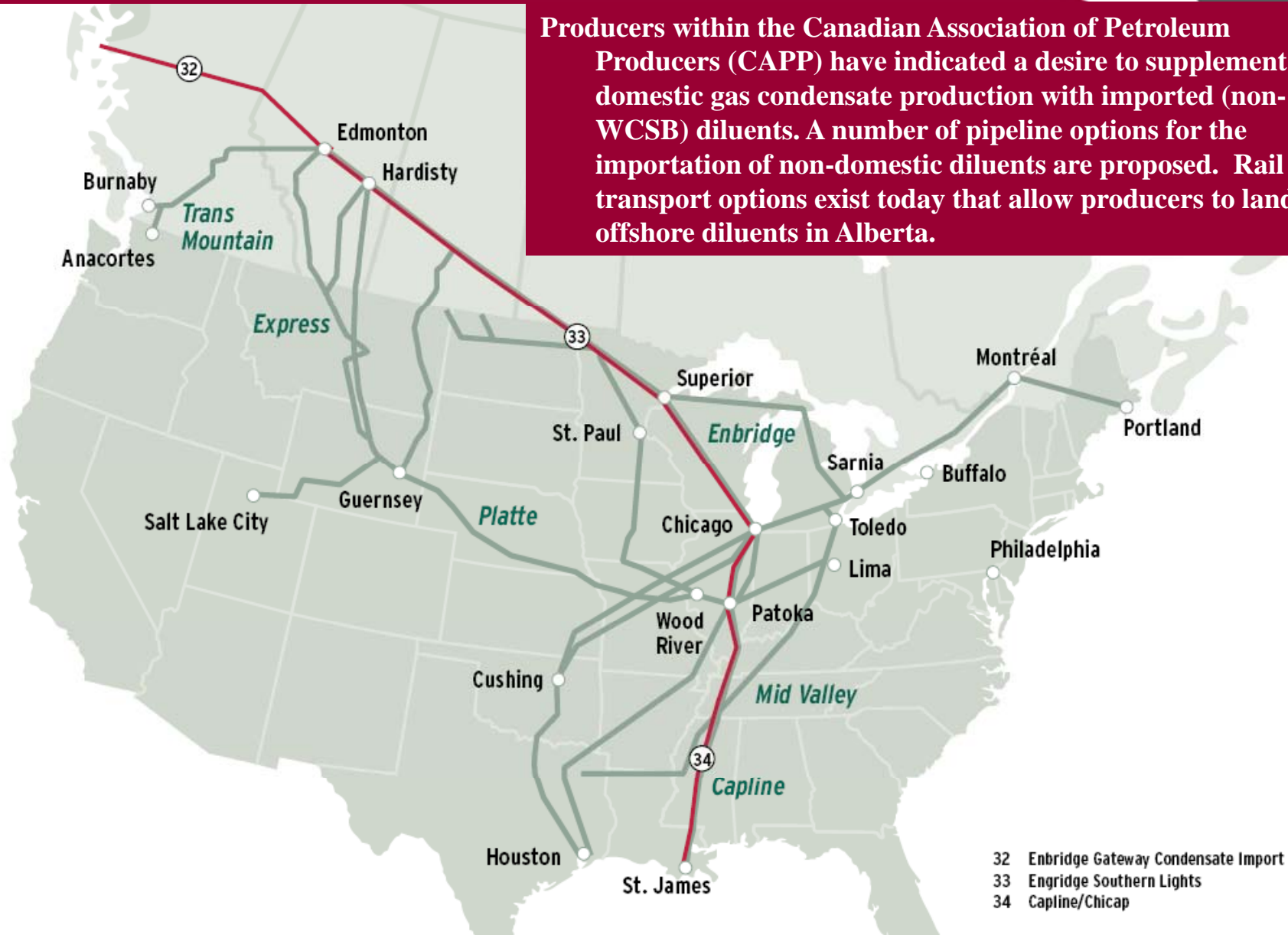
Figure 1.6 Moderate Growth Case Western Canadian Crude Oil Supply



Diluent Pipeline Proposals



Producers within the Canadian Association of Petroleum Producers (CAPP) have indicated a desire to supplement domestic gas condensate production with imported (non-WCSB) diluents. A number of pipeline options for the importation of non-domestic diluents are proposed. Rail transport options exist today that allow producers to land offshore diluents in Alberta.

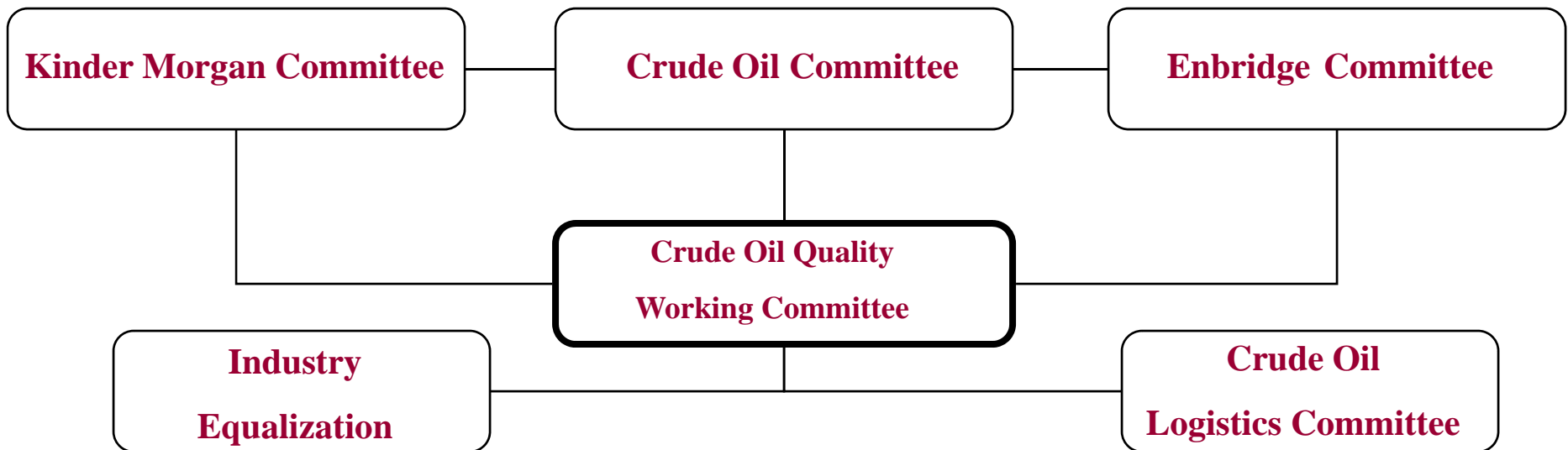


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CAPP Committee structure to manage Crude Quality issues...



CAPP Utilizes Working Committees to lead and manage issues on behalf of the industry. One of these committees, the Crude Oil Quality Committee, is charged with primarily technical items concerning Crude Quality Management for Producers, Refiners and Pipelines. Directives received from many other groups.

List of Crude Oil Quality Committee Members:

Canadian Natural Resources Limited
Devon Canada Corporation
Gibson Energy Ltd.
Ivanhoe Energy Inc.
Marathon Oil Canada Corporation
Shell Canada Limited

CAPP
EnCana Corporation
Husky Energy Inc.
Japan Canada Oil Sands Limited
MEG Energy Corp.
Suncor Energy Inc.

Crude Quality Inc.
ExxonMobil Canada Ltd.
Imperial Oil Resources
Koch Exploration Canada,
Petro-Canada Howes,

CAPP's initiative regarding CRW Quality :

With increased demand for Diluent supply in existing and new crude commodities, work was initiated to establish a reference document so that stakeholders are able to evaluate proposals for new components of the CRW pool, both imported and domestic, that allow full compatibility with domestically produced gas condensate streams that are currently delivered into the pool.

The use of a reference document will ensure the integrity of the CRW diluent pool while providing a variety of import opportunities to WCSB producers.

All proposals for the addition of a new component to the CRW stream must meet specifications and will be reviewed by all CRW stakeholders to ensure that the characteristics of the CRW pool will continue to be acceptable if the proposed component is blended with the CRW stream.

Western Canadian Condensate Enbridge Specifications



An Enbridge working group for CRW is to be formed to assist industry with new stream approvals (with ongoing support from the CAPP Crude Oil Quality Committee). They will leverage a reference document which is divided into specifications and characteristics.

Below are the *Specifications*:

Condensate Specifications for Injections to Enbridge CRW Stream

Current Enbridge CRW Specifications

Quality	Units	Min	Max	Test Method	Enforcement
Density (at 15oC)	kg/m3	600	799	ASTM D-4052 or ASTM D5002	Reallocate to MSW, SLE, SHE etc
Viscosity (at 7.5oC)	cSt		2	ASTM D-445 or D-7042	Reallocate to MSW, SLE, SHE etc
Sulfur, total	Wt%		0.5	ASTM D-5453	Reallocate to MSW, SLE, SHE etc
Olefins, total	Wt%		ND	Proton NMR	Olefinic material can not be blended with any common streams including CRW and its component streams.
Reid Vapour Pressure (RVP)	KPa		103	ASTM D323C	NEB 282 acceptance restriction
BS&W	Vol%		0.5	ASTM D4007-02	NEB 282 acceptance restriction
Organic Chloride	Ppmw		ND	ASTM D4929	NEB 282 acceptance restriction

Western Canadian Condensate Characteristics



The reference document *Characteristics* are below.

These are to be used when considering new additions to the CRW pool.

2007 CRW characteristics – Used as Reference for Evaluation of Proposed New CRW Components						
Quality	Units	2007 Average	-STDev	+STDev	Test Method	Comments
Density (at 15oC)	kg/m3	716	709	723	ASTM D-4052 or ASTM D5002	See above specifications.
Viscosity (at 7.5oC)	cSt	< 2.0	Spot samples only		ASTM D-445 or D-7042	See above specifications.
Sulfur, total	Wt%	0.15	0.07	0.22	ASTM D-5453	See above specifications.
Aromatics, Total (Note 2) (Σ BTEX)	Vol%	5.47	5.19	5.75	PONA or GC-FID	Total percent volume aromatics: this is an indicator of diluent compatibility when blended with bitumen. Diluents with total aromatics exceeding 2.5% are typically compatible with bitumen. Diluents with a lower percentage of aromatics will be monitored
Mercaptans, total	wppm	120 –225	Spot samples only		UOP-163	Increases may be an issue for stakeholders.
H2S (in liquid phase)	wppm		Insufficient data		UOP-163	Increases may be an issue for stakeholders.
Benzene	Vol%	1.17	1.04	1.30	ASTM D-3606	Increases may be an issue for stakeholders.
Mercury	wppm	ND	Spot samples only		ICP	Increases may be an issue for stakeholders.
Selenium	wppm	ND	Spot samples only		ICP	Increases may be an issue for stakeholders.
Oxygenates	Wt%	NEW	Insufficient data		ASTM D-4815	Increases may be an issue for stakeholders.

There was considerable debate over how much (or little) to put on the CRW “specifications”. In leading up to this final specifications and characteristic methodology, several issues were raised.

- 1) Original vision had an “appropriate” number of specifications trying capture potential issues (value, performance, compatibility, regulatory). As discussion took place, an increasing number of specs were considered trying to frame all issues raised becoming unacceptable to manage.
- 2) Initially Traders desired a few simple quality specs to enable prompt trading of cargoes for delivery to the CRW pool with no review of acceptance. This is no longer a requirement imposed. New commodities will need appropriate review time within the Enbridge CRW review process.
- 3) **Adding specifications for certain properties leads to poor practice of blending to a constraint.**
 - 1) Example: taking an existing sweet conventional crude and spiking it with C5's to meet the viscosity spec (not beneficial to the crude industry overall in growing crude oil volume)
 - 2) Example: Blending away a deleterious component or a stream which itself is not within stream specifications (requires dilution to bring a stream “up” to spec)

CRW specification and characteristic references



1. **CAPP CANADIAN CRUDE OIL PRODUCTION FORECAST 2006 – 2020**
(<http://www.capp.ca/raw.asp?x=1&dt=NTV&e=PDF&dn=103586>)
2. **NEB No. 270: EPI Crude Petroleum Tariff Rules and Regulations**
(<http://www.enbridge.com/pipelines/about/pdf/NEB270.pdf>)
3. **NEB 248: Rules and Regulations Governing the Transportation of Refined Petroleum Products**
(<http://www.enbridge.com/pipelines/about/pdf/NEB248Refinedrulesandregs.pdf>)
4. **FERC No. 2** (http://www.terasenpipelines.com/data/2/rec_docs/18_FERC%20No2.pdf)
5. **FERC no. 1456** (http://www.terasenpipelines.com/data/2/rec_docs/29_FERC%20No1456.pdf)
6. **Kinder Morgan Interim Tariff no. 62**
(http://www.terasenpipelines.com/data/2/rec_docs/523_Interim%20NEB%20Tariff%20No%2062.pdf)
7. **Crude compatibility** (Wiehe, I. A. and Kennedy, R. J., US patent 5,871,634 assigned to Exxon, World patent WO 98/26026 and <http://www.solublesolutions.com/oilcomp.html>)
8. **Crude Compatibility** (<http://www.ncut.com/petroleumStabilityCompatability.htm>)
9. **Benzene in Canadian Gasoline** (http://www.ec.gc.ca/cleanair-airpur/CAOL/OGEB/fuels/reports/benz_2001/ben_2001_sec1_2_e.htm#toc)
10. **Condensate Equalization Model** (<http://www.capp.ca/raw.asp?x=1&dt=NTV&e=XLS&dn=88025>)
11. **Various MSDS for domestic condensates**
12. **Shared assays of domestic and potential import diluents**

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Future expanded testing for CRW



Beginning Jan 2008, an expanded CRW testing program was developed.

“SUBJECT: Condensate Testing 2008-2009

In order for the Crude Quality Monitoring Project to remain an effective industry tool, it must present data in a fashion that is consistent with present and developing industry standards. Thus, in anticipation of the Southern Lights Diluent supply scheduled for 2010, we will be modifying the testing program for condensates for 2008-2009. Specifications for condensate testing for the Southern Lights system have been established by the CAPP Crude Quality Committee, and will be employed on condensate samples received as of January 1, 2008. The costs associated with the modified testing schedule are effectively consistent with those already approved for the Crude Quality Monitoring Project's 2008 sampling methods.

This change in testing methods will allow the Crude Quality Monitoring Project to present condensate results that conform not only to industry standards but also to specifications proposed by the Crude Quality Committee for diluent traveling on the Southern Lights system. By implementing these changes in advance of the Southern Lights Project, we intend to produce a cost-effective template to be used by industry to evaluate condensate qualities. We believe our proposed testing schedule (See Table 1.1) could act as a guideline analyses set for any industry member wishing to evaluate condensates.”

Future expanded testing for CRW



Table 1.1 Comparison of Pre-2008 Condensate Testing Schedule to 2008/ 2009 Testing Schedule

Test	Pre-2008	2008/ 2009	Comments
Density	x	x	Industry standard for equalization
Total Sulphur	x	x	Industry standard for equalization
Trace Sulphur		x	Provides information on H ₂ S in liquid, as well as on mercaptan species
C30+		x	Industry standard liquid hydrocarbon analysis for condensates; provides more data than light ends, reports more accurately than HTSD, and includes aromaticity
Light Ends	x		
HTSD	x		
RVP		x	As per pipeline specification of <103kPa
Organo-Phosphorus		x	As per industry specification of <0.5 wppm volatile
Oxygenates		x	As per CAPP specification of “none”, “ND”, or ASTM D4815 MDL of 0.2 mass%
Olefins	x	x	As per CAPP condensate specification of “none detected”
Viscosity		x	As per CAPP condensate specification of <2.0 cSt

Data Link - future testing



See Crude Monitor website for new testing format

example of data...



Adobe Acrobat 7.0 Document

Complete.

Thank You.