	_____	_____
70%	_____	_____
60%	_____	_____

Average Resistance HV to Neutral ___ohms at 25°C. Average Resistance LV line to line
_____ohms at 25°C.

Exciting Current - Amperes HV	_____
Exciting Current Per Cent Full Load	_____
Noise Level	_____
Type of Cooling:	OA/FA/FA

Cooling Losses for	Fans	Pumps
Total No. Required	_____	_____
Total Loss (KW)	_____	_____

Temperature Indicatory Type	_____
Alarm Contacts - (Yes/No)	_____
Oil Level Gauge Type	_____
Contacts - (Yes/No)	_____
No. of HV Ratio Adjusters	_____
Ratio Adjusters Operating Height from Ground	_____
Conservator - (Yes/No)	Yes
Total Weight	_____
Untanking Weight at Heaviest Place	_____

Type and Weight of Oil	
Gallons of Oil	
Main Tank	
Conservator tank	
Height Over HV Leads	
Height Over LV Leads	
Shipping Heights	
Projected Floor Space (Assembled)	
Untanking Height	
Tank Operating Pressure Range	
Tank Designed for Full Vacuum - (Yes/No)	
or Partial Vacuum at	
Cover:	
Welded	X
Bolted	
Impedance % on KVA Base	10% @ 64 MVA
Zero Sequence Impedance percent on KVA Base	

Auxiliaries

Device	No.	Phase	Voltage	FLA	LRA
Fans					

Pumps _____ _____ _____ _____ _____

Other Protective Devices _____

10.1 BUSHING DATA

No of: _____

HV _____

Volts _____

Amp _____

Cat. No. _____

Type _____

Wt. _____

ANSI Std. - (Yes/No) _____

Key _____

Terminal Stud Dia. _____

Thds/in. _____

No. of:

LV _____

Volts _____

Amp _____

Cat. No. _____

Type _____

Wt.	
ANSI Std. - (Yes-No)	
Key	
Terminal Stud Dia.	
Thds/In.	

Surge Arrester:

Manufacturer	ABB
Model	

Deviations or variations from purchaser's specification. (List on separate sheet.)

9. PURCHASER DATA SHEETS – 138 kV, 64/85/106 mva – ABB Design HU-Enron-2C

K.

9.1 GENERAL

Customer		Enron North America Corp.
Elevation Feet above MSL		<3300 feet
Minimum/Maximum Ambient Temperature (°C)		18.33/40
Humidity		100%
Wind Velocity		100 mph
Sound Level (65/85/106 MVA)		79/81/82 dBA
Application		Generator Step Up
Atmospheric Pollution		N.A.
Seismic Zone (per UBC – 1997)		2
Color if other than Vendors Standard		ANSI 70 Light Gray
Number of Units		Two
Equipment Number		N/A
Service Engineer (See Section 2) - (Yes-No)		Yes
Power for Auxiliary Devices		
Fans:	Volts/Phase	230 / 1
Pumps	Volts/Phase	230 / 1

LV Winding	Delta

Insulation: The winding terminal insulation classes and withstand test for which they are designed shall be as follows:

	High H Line	Low X, Y	(Ho) Neutral
Class KV	138	15	15
Full Wave BIL (kV) (Bushing/Winding)	650/550	110/110	110/110
Temp. Rise (°C)	65	65	65
Number of Windings	3	3	1

9.3 WINDINGS

9.3.1 High Voltage

Rated Line Voltage, kV	138
Connection (Delta, Wye, etc)	Grnd Wye
Insulation Level (BIL) kV	550
Taps	
Number	4
Step Size - %	2.5
Number (Below and above normal, full capacity)	+2 & -2
Tap Changer	

Type (Manual or Automatic)	Manual
Operation (Energized-LTC or de-energized)	De-energized
No load taps shall be removed	N/A

9.3.2 Low Voltage

Rated voltage, Kv (X & Y)	13.8
Connection (Delta, Wye, etc.)	Delta
Connection brought out through bushings (Yes/No)	No
Terminal Board for Wye or Delta operation	N/A
Terminal Board for Series or Multiple connection	N/A

9.3.3 Neutral

Connection

Direct Grounding (Yes/No)	Yes, Bushing
Resistance Grounding	N/A
Resistance, ohms	
Time, sec.	
Voltage, volts	
Current, amps.	

9.3.4 Angular Displacement ANSI Standard

9.4.1 High Voltage

Overhead Line	Yes
Underground Cable	N/A
Bus	
Location	
Top	Yes
Sidewall	
High voltage line bushings will be located:	Top
ANSI Segment	3
HV bushing material	Porcelain

9.4.2 Low Voltage

Overhead Line	
Underground Cable	
Bus	Cable Bus-Flange Connection
Location	Segment 1
Top	-
Sidewall	Yes
LV Bushing Material	Porcelain

9.4.3 Neutral Location of:

	High Voltage	Low Voltage

	Neutral Bushing	Neutral Bushing
On transformer cover	Yes	Not Applicable
Neutral Bushing Material	Porcelain	

9.4.4 High, low, and neutral bushings shall be located as previously described, be porcelain and rated as follows:

Terminals	H	X & Y	(Ho)
Number	3	3 each	1
KV Class	138	15	15
BIL (KV)	650	110	110
Amperes	* Std.	* Std.	* Std.
Creepage Distance (in)			

(All transformer bushings shall have bronze threaded studs. Terminals will be furnished by others).

* Vendor to determine.

9.4.5 Cable Data – To be supplied Later N/A

9.5 ACCESSORIES

9.5.1 Phase Current Transformers - (Yes/No) Yes

Item	HV	LVX	LVY
Relaying	3 per phase 1200:5,MR,C800	2 per phase 4000:5,MR,C800	2 per phase 4000:5,MR,C800
Metering			
Trans. OL Protection			

9.5.2	**Neutral Current Transformers - (Yes/No)**	Yes
	If yes, Ratio:	1 x 1200:5,MR
	Accuracy Class	C800
9.5.3	**Sudden (Fault) Pressure Relay (63) (Buchholz) Required**	Yes
9.5.4	**Thermal Relay (49) Required - (Yes/No)**	Yes
9.5.5	**Surge Arrestor Required - (Yes/No)**	Yes
	Rating	88MCOV; 110KV
	Type	ABB#Q110XA088A Metal-Oxide

9.6 ALARM CONTACT RATINGS

Non-grounded alarm contacts shall be suitable for interrupting:

1) 0.02-ampere direct-current inductive load
2) 0.20-ampere direct-current non-inductive load
3) 2.5-ampere alternating-current non-inductive or inductive load
6) 250 volts maximum in all classes
7)

10. VENDOR DATA SHEETS

These data sheets are supplementary to the data sheets in Attachments A, B, and C, if attached.

Equipment No.	HU-ENRON-2C
Vendor	ABB
Purchase Order No.	NEG#FC0111400-2C
Item No.	
Factory Location	St. Louis, MO
Factory Address	
Vendor's Requisition No.	
Serial No.	
Shop Order No.	
Unit Purchase Price (If not given on Purchase Tender)	
Instruction Book No.	
Replacement Parts Book No.	
Voltage Rating	138KV
KVA Rating at 55°C	N.A.
KVA Rating at 65°C	106,667
Voltage Tap Settings (No Load)	
BIL	
Pri.	550 KV

Sec.	110KV
Form:	
Core	
Shell	Core
Outline Drawing No.	
Control Diagram Drawing No.	
Elementary Diagram Drawing No.	
Connection Diagram Drawing No.	
No-Load Loss at Rated Voltage – KW	43.2 = N.L. 138.6 = L.L. @ 64 MVA
Total Losses, Including Auxiliary Losses at Full Load-Watts Equal to 90.1 MW at 0.85 pf, or 106 MVA.	Aux. = 7.2 @106 MVA

% Efficiency at % Rated Load Equal to 64 MVA:

150%	
100%	
75%	
50%	
25%	

% Regulation at Rated Load

Load	PF 100%	PF 85%
100%		
90%		
80%		
70%		
60%		

Average Resistance HV to Neutral ___ohms at 25°C. Average Resistance LV line to line
_____ohms at 25°C.

Exciting Current - Amperes HV	
Exciting Current Per Cent Full Load	
Noise Level	
Type of Cooling:	OA/FOA/FOA
Cooling Losses for	**Fans** **Pumps**
Total No. Required	
Total Loss (KW)	
Temperature Indicatory Type	
Alarm Contacts - (Yes/No)	
Oil Level Gauge Type	
Contacts - (Yes/No)	
No. of HV Ratio Adjusters	
Ratio Adjusters Operating Height from Ground	
Conservator - (Yes/No)	Yes
Total Weight	
Untanking Weight at Heaviest Place	
Type and Weight of Oil	

Gallons of Oil	
Main Tank	
Conservator tank	
Height Over HV Leads	
Height Over LV Leads	
Shipping Heights	
Projected Floor Space (Assembled)	
Untanking Height	
Tank Operating Pressure Range	
Tank Designed for Full Vacuum - (Yes/No)	
or Partial Vacuum at	
Cover:	X
Welded	
Bolted	9% @ 64 MVA
Impedance % on KVA Base	
Zero Sequence Impedance percent on KVA Base	

Auxiliaries

Device	No.	Phase	Voltage	FLA	LRA
Fans					
Pumps					

Other Protective Devices

10.1 BUSHING DATA

No of:	
HV	3
Volts	138,000
Amp	800
Cat. No.	138W0800AA
Type	ABB Type O + C Dwg. #P3946C190
Wt.	450
ANSI Std. - (Yes/No)	Yes
Key	
Terminal Stud Dia.	
Thds/in.	
No. of:	
LV	6
Volts	25,000
Amp	3,000
Cat. No.	ABB 025T0300HS
Type	Type T
Wt.	150

ANSI Std. - (Yes-No)	Yes
Key Drawing #P3943 C 190	
Terminal Stud Dia.	
Thds/In.	

Surge Arrester:

Manufacturer	ABB
Model	Q110XA088A

Deviations or variations from purchaser's specification. (List on separate sheet.)

9. PURCHASER DATA SHEETS – 138 kV, 84/112/140 mva
M. ABB Design HU – Enron-2D-LS

9.1 GENERAL

Customer		Enron North America Corp.
Elevation Feet above MSL		<3300 Feet
Minimum/Maximum Ambient Temperature (°C)		5/40
Humidity		100%
Wind Velocity		100 mph
Sound Level (84/112/140 MVA)		70/72/73 dBA
Application		Generator Step Up
Atmospheric Pollution		Later
Seismic Zone (per UBC – 1997)		Later
Color if other than Vendors Standard		ANSI 70 Light Gray
Number of Units		2 (two)
Equipment Number		N/A
Service Engineer (See Section 2) - (Yes-No)		Yes
Power for Auxiliary Devices		
Fans:	Volts/Phase	230 / 1
Pumps	Volts/Phase	230 / 1

Aux.	Volts/Phase	120	1
Heaters	Volts/Phase	120	1

9.2 RATINGS

MVA (at 65°C rise)	84/112/140
Type	Oil Filled
Type (Cooling)	OA/FA/FA
High Voltage, kV	138
Low Voltage, kV	13.8
Number of Phases	3
Frequency, Hertz	60
Oil Preservation System (Sealed tank, Inert gas, Conservator)	Conservator
Insulation/Coolant (Mineral oil, askarel)	Mineral Oil
Impedance - % on OA base (84 MVA base)	9 %

Impedance will be rated at the listed percentage at rated (MVA) voltage and self-cooled MVA.

System Fault Current RMS Symmetrical, kA	ANSI C57.12.00 Sec 7.1.5
Grounding	
HV Winding	Grnd wye

LV Winding	Delta

Insulation: The winding terminal insulation classes and withstand test for which they are designed shall be as follows:

	High H Line	Low X	(Ho) Neutral
Class KV	138	15	15
Full Wave BIL (kV) (Bushing/Winding)	650/650	110/110	110/110
Temp. Rise (°C)	65	65	65
Number of Windings	3	3	1

9.3 WINDINGS

9.3.1 High Voltage

Rated Line Voltage, kV	138
Connection (Delta, Wye, etc)	Grnd wye
Insulation Level (BIL) kV	650
Taps	
Number	4
Step Size - %	2.5
Number (Below and above normal, full capacity)	+2 & -2
Tap Changer	

Type (Manual or Automatic)	Manual
Operation (Energized-LTC or de-energized)	De-energized
No load taps shall be removed	N/A

9.3.2 Low Voltage

Rated voltage, Kv	13.8
Connection (Delta, Wye, etc.)	Delta
Connection brought out through bushings (Yes/No)	No
Terminal Board for Wye or Delta operation	N/A
Terminal Board for Series or Multiple connection	N/A

9.3.3 Neutral

Connection

Direct Grounding (Yes/No)	Yes, Bushing, External
Resistance Grounding	N/A
Resistance, ohms	
Time, sec.	
Voltage, volts	
Current, amps.	

9.3.4 Angular Displacement — ANSI Standard

9.4 CONNECTIONS

9.4.1 High Voltage

Overhead Line	Yes
Underground Cable	N/A
Bus	
Location	
Top	Yes
Sidewall	
High voltage line bushings will be located:	Top
ANSI Segment	3
HV bushing material	Porcelain

9.4.2 Low Voltage

Overhead Line	
Underground Cable	
Bus	Cable Bus-Flange Connection
Location	Segment 1
Top	-
Sidewall	Yes
LV Bushing Material	Porcelain

9.4.3 Neutral Location of:

	High Voltage Neutral Bushing	Low Voltage Neutral Bushing
On transformer cover	Yes	Not Applicable
Neutral Bushing Material	Porcelain	

9.4.4 High, low, and neutral bushings shall be located as previously described, be porcelain and rated as follows:

Terminals	**H**	**X**	**(Ho)**
Number	3	3	1
KV Class	138	15	15
BIL (KV)	650	110	110
Amperes	*	*	*
Creepage Distance (in)	Later	Later	Later

(All transformer bushings shall have bronze threaded studs. Terminals will be furnished by others).

* Vendor to determine.

9.4.5 Cable Data – To be supplied Later N/A

9.5 ACCESSORIES

9.5.1 Phase Current Transformers - (Yes/No) Yes

Item	**HV**	**LVX**	
	3 per phase	2 per phase	
Relaying	1200:5,MR,C800	8000:5,MR,C800	
Metering			
Trans. OL Protection			

9.5.2	**Neutral Current Transformers - (Yes/No)**	Yes
	If yes, Ratio:	1 x 1200:5,MR
	Accuracy Class	C800
9.5.3	**Sudden (Fault) Pressure Relay (63) (Buchholz) Required**	Yes
9.5.4	**Thermal Relay (49) Required - (Yes/No)**	Yes
9.5.5	**Surge Arrestor Required - (Yes/No)**	Yes
	Rating	Later kV MCOV
	Type	Metal-Oxide

9.6 ALARM CONTACT RATINGS

Non-grounded alarm contacts shall be suitable for interrupting:

1) 0.02-ampere direct-current inductive load
2) 0.20-ampere direct-current non-inductive load
3) 2.5-ampere alternating-current non-inductive or inductive load
4) 250 volts maximum in all classes

10. VENDOR DATA SHEETS

These data sheets are supplementary to the data sheets in Attachments A, B, and C, if attached.

Equipment No.	HU-Enron-2D-LS Low Sound
Vendor	ABB Neg#FC011400-2D-LS
Purchase Order No.	
Item No.	
Factory Location	St. Louis, MO
Factory Address	
Vendor's Requisition No.	
Serial No.	
Shop Order No.	
Unit Purchase Price (If not given on Purchase Tender)	
Instruction Book No.	
Replacement Parts Book No.	
Voltage Rating	138,00
KVA Rating at 55°C	N.A.
KVA Rating at 65°C	140,000
Voltage Tap Settings (No Load)	