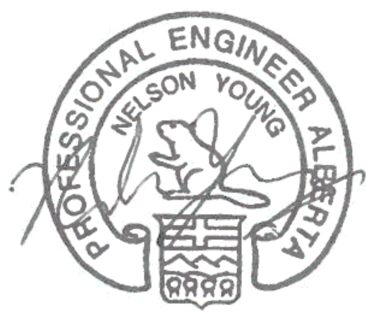
ATCO

Distribution Deficiency Report

Mariana Lake Load Addition



February 18, 2022
ID# 81765

PERMIT TO PRACTICE
ATCO ELECTRIC LTD.

RM SIGNATURE: ____________

RM APEGA ID #: 81765

DATE: February 18, 2022

PERMIT NUMBER: P000850
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

	Name	Date
Prepared by	Rachel Liu	Feb 18, 2022
Reviewed by	Nelson Young	Feb 18, 2022

February 18, 2022

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Revision History:

R0	SASR Submission	Rachel Liu	September 11, 2020
R1	Mariana DTS, Tables in MVA	Rachel Liu	October 2, 2020
R2	Updated per AESO Comments	Rachel Liu	November 23, 2020
R3	Updated Load Forecast	Rachel Liu	February 18, 2022

1 Executive Summary

ATCO Electric Distribution Division (ATCO DFO) has received a request to serve a pump station development near Mariana 833S in ATCO Electric's Woodlands area ("the Project"). Mariana 833S POD substation is located approximately 90 km south of Fort McMurray in the Alberta System Electric Operator's (AESO) Northeast Planning Region.

Due to the inability of the existing distribution network to meet the customer's load request and start the motors for this specific pump station from existing area PODs, ATCO DFO requests a transmission solution.

ATCO DFO has considered the following transmission-based alternatives:

<u>Transmission Alternative 1:</u> 144/25 kV 144/25 kV Transformer Addition at Mariana 833S;

<u>Transmission Alternative 2:</u> New POD near the Project location.

ATCO DFO has determined that Alternative 2 is the only alternative that meets the needs of the customer's request.

The requested In-Service Date (ISD) of the proposed new POD is April 1, 2023.

2 Introduction

2.1 Customer Request and In-Service Date (ISD)

ATCO DFO received a load request from an industrial customer for a pump station development ("the Project") at the Legal Site Description (LSD) NE-33-80-13 W4M. The customer is planning to add 28.8 MW of the total operating load. The largest pump station motor loads will consist of 20,000 horsepower (HP) motors with Variable Frequency Drive (VFD) starting assistance.

Table 2.1-1 details the requested Demand Transmission Service (DTS) and the requested ISD.

Table 2.1-1: Mariana Area New Customer Request

Location	Load Type Characterization	Loads	Requested DTS (MW)	Requested ISD/Energization Date
NE-33-80-13 W4M	Industrial	2 x 20,000 HP[N1], 1.9 MW – other small motors loads; 0.6 MW – heat and lighting utilities	28 MW	April 1, 2023

N1: motor load secondary will be 13.8 kV

2.2 Existing System

Figure 2.2-1 shows the existing Transmission system in relation to the Project load request. It should be noted that McMillan 885S is a 240/144 kV switching substation with no 25 kV source and will not be discussed as a possible connection to serve the load via distribution.

There are several PODs with 25 kV service near the Project. Table 2.2-1 below shows the distance between the Customer location and surrounding 25 kV distribution systems. Figure 2.2-2 provides an expanded view of the Project location in relation to the closest existing POD, Mariana 833S.

Table 2.2-1: Distribution Connection Distances from the Project to Surrounding 25 kV Systems

POD	Distance from the Project (km)	Existing Load Type (%)			
		Commercial	Transportation	Industrial	Total
Mariana 833S	1.5	0.0	41.2	58.8	100
Horse River 917S	18.5	8.2	0.3	91.5	100
Crow 860S	36	0.5	99.4	0.1	100
Sweetheart Lake 2032S	37	--	2.6	97.4	100
Algar 875S	41	9.2	70.7	20.1	100

The potential Project connections to the nearby substations are discussed below listed from closest to the Project to farthest from the Project as per Table 2.2-1:

1. Mariana 833S is located west of the Project. Mariana 833S has a three winding 144 kV/25/4.16 kV transformer, with one (1) 25 kV breaker and one (1) 4.16 kV breaker. Each secondary winding has a maximum capacity of **16.6 MVA** with the overall combined transformer maximum capacity of 25 MVA.

   Please refer to Appendix A Table A-1 for the existing load forecast table.

2. Horse River 917S is located north of the Project. It has a 50 MVA 144 kV/25 kV transformer and three (3) 25 kV breakers.

   Please refer to Appendix A Table A-2 for the existing load forecast table.

3. Crow 860S is located south of the Project. It has a three winding 144 kV/25/4.16 kV transformer, with one (1) 25 kV breaker and one (1) 4.16 kV breaker. The overall combined transformer capacity is **16.6 MVA**.

   Please refer to Appendix A Table A-3 for the existing load forecast table.

4. Sweetheart Lake 2032S is located north of the Project. Sweetheart Lake substation has a 42 MVA 144 kV/25 kV transformer with two (2) 25 kV breakers.

   Please refer to Appendix A Table A-4 for the existing load forecast table.

5. Algar 875S is located north of the Project. Like Mariana 833S, Algar 875S has a three winding 144 kV/25/4.16 kV transformer, with one (1) 25 kV breaker and one (1) 4.16

kV breaker. Each secondary winding has a maximum capacity of **16.6 MVA** with the overall combined transformer maximum capacity of 25 MVA.

Please refer to Appendix A Table A-5 for the existing load forecast table.

Figure 2.2-1 – Transmission system near load request

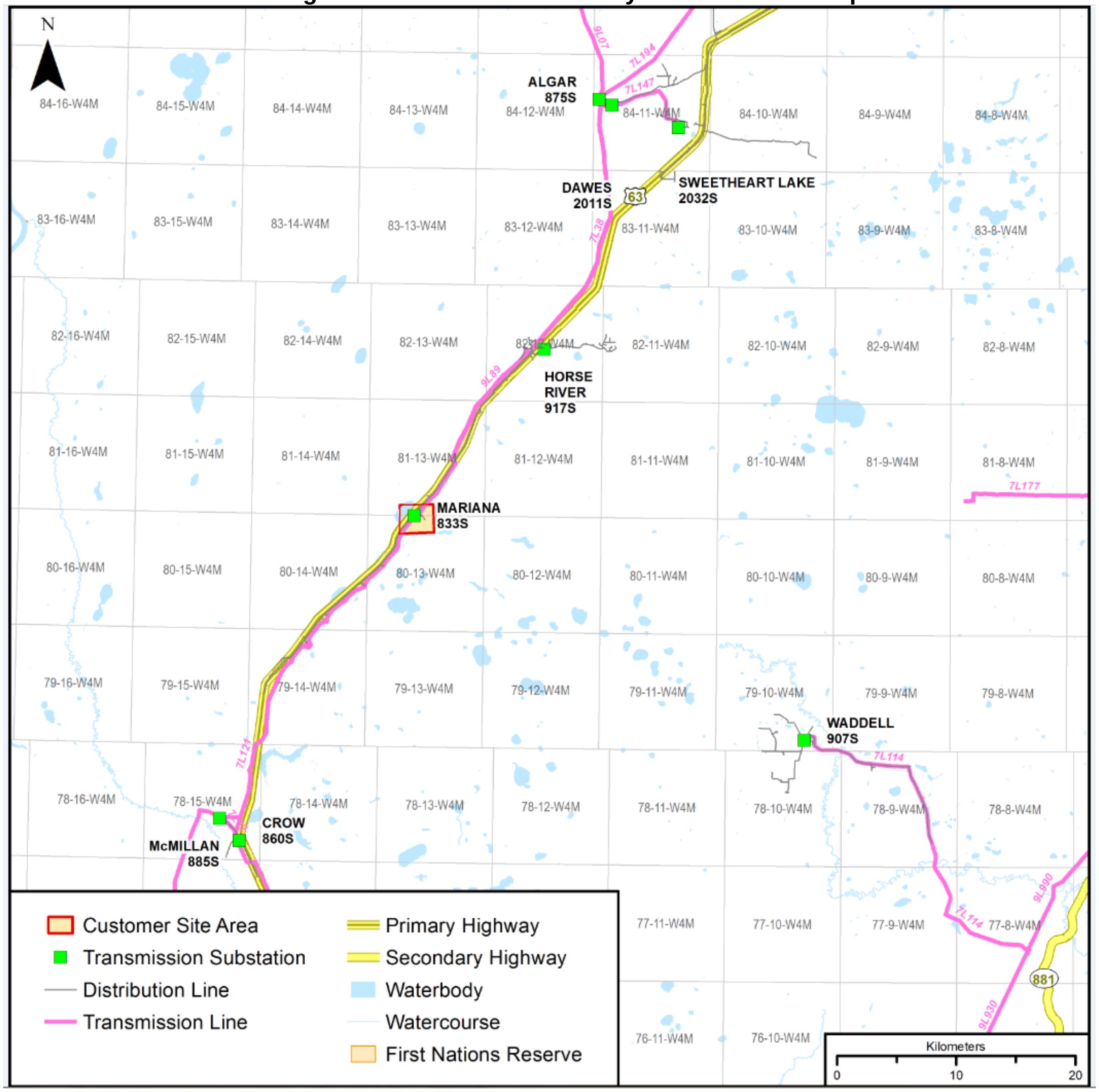
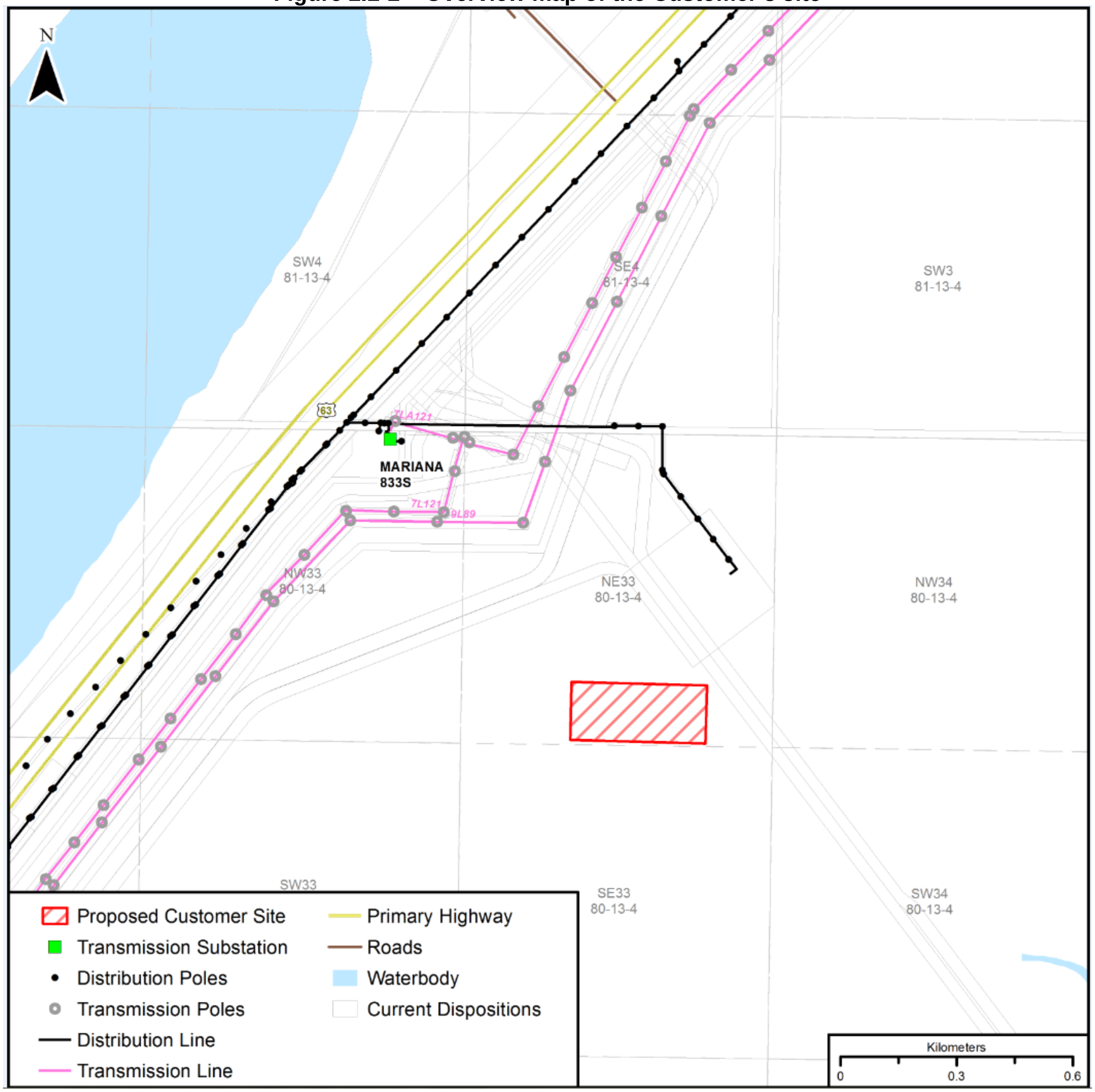


Figure 2.2-2 – Overview map of the Customer's site



3 Distribution Only Alternative Analysis

3.1 Serving the Load Request from Mariana 833S

Of the area substations with existing 25 kV supply identified in Table 2.2-1 and shown in Figure 2.2-2, Mariana 833S is the closest POD to the project. However, the existing transformer at Mariana 833S does not have sufficient capacity to serve the proposed request. Refer to Section 2.2.

Project P2384 will execute a DTS reduction from 13.0 MW to 8.2 MW at Mariana 833S. The load forecast table Appendix A Table A-1 reflects the changed DTS.

There are no distribution generators connected into this substation. There are no known future distribution generators planned to be connected into this substation.

3.2 Serving the Load Request from Horse River 917S

Horse River 917S is the next closest POD to the Project which has sufficient capacity to accommodate the Project. However, due to the motor starting distribution technical deficiency detailed below, distribution supply from Horse River POD is rejected:

- The 20,000 HP motor fails to meet the ATCO DFO motor start standards even with VFD-assisted motor start. The DFO voltage limits during start would be violated.
  - The voltage flicker level exceeds the 6% daily limit at the future Project point of common coupling.
    - Starting the 20,000 hp motor causes over 15% flicker at the point of common coupling
  - The lowest voltage during a motor start at the Customer's PCC does not meet the minimum voltage requirement of 91.6%. The lowest voltage anywhere on the distribution network does not meet the minimum voltage requirement of 90%.
    - The voltage at the Customer's PCC during the motor start falls to 87.7%.
    - The distribution system is not able to start the motor with a VFD. The low voltage during the motor start will interrupt service to other loads on the same distribution line including at the Project.

Please refer to Appendix B for information on the applicable ATCO DFO Planning Criteria.

There is a 15 MW distribution generator connected onto 5L722 at Horse River 917S. This DG is not relevant to the motor start distribution deficiency for the Project. There are no known future additional distribution generators planned to be connected into this substation.

3.3 Serving the Load Request from Crow 860S

Crow 860S does not have the capacity to serve the Project. Supply from Crow 860S was not further investigated given the longer distribution feeder distance and the motor start technical deficiency would apply as detailed in section 3.2. Please refer to Appendix B for information on the applicable ATCO DFO Planning Criteria.

There are no distribution generators connected into this substation. There are no known future distribution generators planned to be connected into this substation.

3.4 Serving the Load Request from Sweetheart Lake 2032S

Sweetheart Lake 2032S does not have the capacity to serve the Project. Supply from Sweetheart Lake 2032S was not further investigated given the longer distribution feeder distance and the motor start technical deficiency would apply as detailed in section 3.2.

Please refer to Appendix B for information on the applicable ATCO DFO Planning Criteria.

There are no distribution generators connected into this substation. There are no known future distribution generators planned to be connected into this substation.

3.5 Serving the Load Request from Algar 875S

Algar 875S does not have the capacity to serve the Project. Supply from Algar 875S was not further investigated given the longer distribution feeder distance and the motor start technical deficiency would apply as detailed in section 3.2.

Please refer to Appendix B for information on the applicable ATCO DFO Planning Criteria. There are no distribution generators connected into this substation. There are no known future distribution generators planned to be connected into this substation.

4 Need for Development

4.1 Driver

The need for transmission development is driven by the inability to start the large motor andlack of substation capacity to supply the Project from the existing PODs in the area as discussed in Section 3.

5 Transmission-Based alternatives

Two transmission-based alternatives were considered and are described in Sections 5.1 and 5.2.

Transmission Alternative 1:	144/25 kV Transformer Addition at Mariana 833S;
Transmission Alternative 2:	New POD near the Project location.

5.1 Transmission Alternative 1: 144/25 kV Transformer Addition at Mariana 833S

An additional 144/25 kV transformer at Mariana 833S with sufficient capacity to serve the Project with two 25kV feeder breakers and approximately 2 km of new 25 kV double circuit line would be installed for this alternative source.

Table C-1 in Appendix C shows the Mariana 833S POD new transformer forecast with the proposed load development. Please refer to Appendix A Table A-1 for the existing load forecast table indicating lack of capacity on the existing transformer for the Project.

Expansion of Mariana 833S is not feasible due to the immediate area being very highly constrained by other existing facilities. Mariana 833S POD is embedded in the North East corner of an existing pump station. Mariana 833S POD is surrounded by pipelines that would prevent substation expansion. For this reason, Transmission Alternative 1 has been rejected.

5.2 Transmission Alternative 2: New POD near the Project location

Proposed Transmission System Development:

The assumed transmission development for this alternative involves constructing a new transmission connection and a new 144/25 kV POD with sufficient capacity to serve the Project including one 25kV feeder breaker. Table C-2 in Appendix C shows the new POD forecast with the proposed load development.

The transmission line connection from the new POD to Alberta Interconnected Electric System (AIES) will be assessed and determined by the AESO and the Transmission Facility Owner (TFO).

ATCO DFO suggests the new POD be developed adjacent to the Customer proposed load centre to maximize the distribution connection’s technical performance.

Proposed Distribution System Development:

- Distribution system development is not applicable for this alternative. Customer facilities are to be built adjacent to Transmission facilities.
- The 20,000 HP motor will require a VFD start assistance to limit the motor start inrush current.

5.3 Transmission Alternatives Distribution Estimates

Table 5-1 provides a summary of each viable transmission alternative for distribution scope and associated distribution cost estimate.

Table 5-1 Transmission Alternatives Distribution Scope and Estimates

Transmission Alternative	Distribution Scope	Estimated Distribution Cost
Transmission Alternative 2 – New POD near the Project location	• Not applicable	$0M ($2022, +/- 30%)

6 Recommendation

Based on the Distribution deficiencies of the Distribution Alternatives, and the information provided from ATCO TFO that Transmission Alternative 1 is not viable, Transmission Alternative 2 is the only viable option which allows the connection of the Customer's load to the AIES. ATCO DFO requests an ISD for this development of April 1, 2023.

Appendix A: Existing POD Load Forecast Tables

Table A-1 – Mariana 833S POD Existing Load Forecast

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5L539	1.5	4.0	3.7	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
3L205	8.2	7.1	7.6	8.7	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Transformer Total	7.3	8.4	8.5	8.9	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Remaining Reg Capacity	17.9	15.4	15.7	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Remaining 25 kV Capacity	15.1	12.6	12.9	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Remaining 4.16 kV Capacity	8.4	9.5	9.0	7.9	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Remaining Xmer Capacity	17.7	16.6	16.5	16.1	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8

Notes:

1) Mariana POD and feeders power factor is 0.95.
2) No capacity or expansion possibilities exists at Mariana 833S, so the future Project load cannot be served from this substation and N-1 supply tables are not applicable.
3) Loss of the Mariana 833S transformer causes all load to be unsupplied until the emergency spare replaces the equipment. The loss of the 25 kV breaker will cause bypass equipment to be closed and system setting changes to accommodate the emergency. Load will be restored once this work is completed.
4) Distribution N-1 supply. Please note there is no N-0 issues to identify.
   In case of 25 kV feeder fail, all 25 kV load remains unsupplied until repairs are completed.

Table A-2 – Horse River 917S POD Existing Load Forecast

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5L722	15.9	17.0	15.6	17.1	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
5L750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5L780	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transformer Total	16.8	15.9	17.0	17.1	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Remaining Reg Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Remaining Xmer Capacity	33.2	34.1	33.0	32.9	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6

Notes:

1) Horse River POD and feeders power factor is 0.94.
2) The future Project cannot be served from Horse River 917S for technical deficiencies so N-1 supply tables not applicable.
3) Loss of the Horse River 917S transformer requires the Customer to support load with on-site generation until the emergency spare is installed. In the case of 25 kV breaker failure, the load will be transferred to the adjacent breaker and be fully restored.
4) Distribution N-1 supply. Please note there is no N-0 issues to identify.
   In case of 25 kV feeder fail, all 25 kV load remains unsupplied until repairs are completed.

Table A-3 – Crow 860S POD Existing Load Forecast

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	**2016/2017**	**2017/2018**	**2018/2019**	**2019/2020**	**2020/2021**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
5L018	3.4	3.5	3.5	3.4	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
3L214	1.7	2.1	3.4	4.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Transformer Total	5.1	4.8	6.8	5.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Remaining Reg Capacity	13.6	13.5	13.5	13.6	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Remaining H-X Capacity	13.2	13.1	13.1	13.2	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Remaining H-Y Capacity	14.9	14.5	13.2	12.6	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Remaining Xmer Capacity	11.5	11.8	9.8	10.9	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6

Notes:

1) Crow POD and feeders power factor is 0.97.
2) The future Project cannot be served from Crow 860S for technical deficiencies so N-1 supply tables not applicable.
3) Loss of the Crow 860S transformer or 25 kV breaker causes all load to be unsupplied until the emergency spare replaces the equipment.
4) Distribution N-1 supply. Please note there is no N-0 issues to identify.
   In case of 25 kV feeder fail, all 25 kV load remains unsupplied until repairs are completed.

Table A-4 – Sweetheart Lake 2032S POD Existing Load Forecast

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	**2016/2017**	**2017/2018**	**2018/2019**	**2019/2020**	**2020/2021**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
5L768	2.1	11.9	14.3	14.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
5L764	0.5	1.6	1.7	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Transformer Total	2.2	13.1	15.6	15.8	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
Remaining Reg Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Remaining Xmer Capacity	39.4	28.5	26.0	25.8	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6

Notes:

1) Sweetheart Lake POD and feeders power factor is 0.92.
2) The future Project cannot be served from Sweetheart Lake for technical deficiencies so N-1 supply tables not applicable.
3) Loss of the Sweetheart Lake transformer causes all load to be unsupplied until the emergency spare replaces the equipment. In the case of 25 kV feeder breaker failure, the load will be transferred to the adjacent breaker and be fully restored.
4) Distribution N-1 supply. Please note there is no N-0 issues to identify.
   In case of 25 kV feeder fail, all 25 kV load remains unsupplied until repairs are completed.

Table A-5 – Algar 875S POD Existing Load Forecast

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	**2016/2017**	**2017/2018**	**2018/2019**	**2019/2020**	**2020/2021**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
5L304	8.0	7.2	4.9	8.6	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
3L204	6.3	9.1	8.5	7.2	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Transformer Total	13.4	13.6	11.1	13.3	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Remaining Reg Capacity	9.2	10.1	12.3	8.7	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
Remaining H-X(25KV) Capacity	8.6	9.4	11.7	8.0	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Remaining H-Y(4160V) Capacit	10.3	7.5	8.1	9.4	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Remaining Xmer Capacity	11.6	11.4	13.9	11.7	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1

Notes:

1) Algar POD and feeders power factor is 0.94.
2) No capacity exists at Algar POD and technical deficiencies would also reject this POD, so the future Project load cannot be served from this substation and N-1 supply tables are not applicable.

3) Loss of the Algar 875S transformer causes all load to be unsupplied until the emergency spare replaces the equipment. The loss of the 25 kV breaker will cause bypass equipment to be closed and system setting changes to accommodate the emergency. Load will be restored once this work is completed.
4) Distribution N-1 supply. Please note there is no N-0 issues to identify.
   In case of 25 kV feeder fail, all 25 kV load remains unsupplied until repairs are completed.

Appendix B – ATCO DFO Planning Criteria

To ensure new loads are connected in a safe and reliable way to the distribution system, connections must follow ATCO DFO Planning Criteria. Criteria applicable in this study are highlighted below:

25 kV Voltage Levels: the voltage threshold on ATCO DFO's 25 kV systems, under normal conditions, at large Customer sites must remain above **0.97 V pu** and below **1.04 V pu.**

Guideline for Motor Starting: During the customer motor starting operation (assuming the time between starts 1 hr < T < 24 hr, Rural area), ATCO DFO 25 kV system must remain above:

- **0.95 Vpu** with a flicker at or below 5% at POD,
- **0.90 Vpu** with a flicker level at or below 6% anywhere on 25 kV system, and
- **0.916 Vpu** with a flicker level at or below 6% at customer 25 kV connections

Appendix C: Transmission Based Alternatives Load Forecast with Future Project Load

Table C-1 – Mariana 833S New Transformer Load Forecast with the Load Request

702T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5LNEW1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
5LNEW2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Transformer Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0

Notes:

1) This is the load forecast for the proposed new transformer at Mariana 833S. For the load forecast of the existing transformer at Marianna 833S, please refer to Appendix A Table A-1.
2) This load forecast is supplied as per the requirement of this report. This Alternative is not viable due to the inability to expand Mariana substation.
3) ATCO DFO assumes new POD and feeder power factors of 90.0%.
4) The total Project 29 MW load will be split evenly between the two new feeders.
5) In case of a feeder failure, part of the load (approximately 10 MVA) can be put on the other feeder (feeder contingency). The rest of the Project load will remain unserved (6 MVA).
6) In case of the distribution site transformer failure, part of the load can be put on the other site distribution transformer (distribution transformer contingency). The amount of this load will depend on the size of the installed transformer and is assumed to be approximately 4 MVA. The rest of the Project load will remain unserved (12 MVA).
7) In case of the proposed 144/25 kV transformer failure, part of the Project load could be put on the existing transformer (substation transformer contingency). The amount of the new load that can be transferred to the existing transformer would be approximately 10.8 MVA (each winding is limited to 16.6 MVA). The rest of the Project load would remain unserved (21.2 MVA).

Table C-2 – New POD Load Forecast with the Load Request

701T	Actual (MVA)					Forecast (MVA)									
Sub/Fdr	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5LNEW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
Transformer Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0

Notes:

1) ATCO DFO assumes new POD and feeder power factors of 90.0%.
2) The total future Project 29 MW load will be split evenly between the two new feeders.
3) In case of the feeder failure, part of the load (approximately 10 MVA) can be put on the other feeder (feeder contingency). The rest of the Project load will remain unserved (6 MVA).
4) In case of the distribution site transformer failure, part of the load can be put on the other site distribution transformer (transformer contingency). The amount of this load will depend on the size of the installed transformers and is assumed to be approximately 4 MVA. The rest of the Project load will remain unserved (12 MVA).
5) In case of the proposed 144/25 kV transformer failure, the load will remain unsupplied until the emergency spare replaces the equipment.