Distribution System Study

History of GPA Medium Range Distribution Planning

- GPA performed a comprehensive medium range distribution study in 1992 and in 2010 under the Engineering Department.
- The responsibility for this study was reorganized under the Strategic Planning & Operations Division in 2020.
- Under this arrangement, both SPORD and the Engineering Distribution Section will work on the study. SPORD will take primary responsibility for the study. Engineering will provide valuable insights into distribution system operations as well as document ad hoc distribution planning.

Project Partners

- Internal GPA Team
  - AGMETS
  - Engineering/Distribution Section
  - Engineering/Real Estate Section (GIS)
  - Engineering/Transmission Section
  - SPORD/System & Smart Grid Planning Section
  - SPORD/Strategic Planning & Energy Contracting Section
  - SPORD/Demand-Side Management & Green Programs Section
  - Information Technology Division
  - Chief Financial Officer (Rates)
- External Team
  - Landis & Gyr (L+G)
  - Utility Financial Solutions LLC (UFS)

Distribution Study Scope Using Advanced Grid Analytics (L+G)

Priority	Tasks
1	One (1) AGA System Assessment
2	Distribution Model Corrections Study (via AGA Network Model Validator)
3	Load Flow Studies (via AGA Asset Loading)
4	Distributed Renewable Energy Intermittency and Voltage Issue Elimination/Management Study (via AGA Planning Case Studies)
5	System Wide Voltage Analysis Study (via AGA Voltage Visualization)
6	Volt/VAR Optimization Study (via AGA Planning Case Studies)
7	Conservation Voltage Reduction Study (via AGA Capacity Contribution as well as Voltage Visualization and Planning Case Studies)
8	Demand Response Study (via AGA Capacity Contribution and Planning Case Studies)
9	Automated Switching and Communicating Fault Circuit Indicator Study (via GIS model analysis)
10	One (1) electronic document that catalogs all distribution design studies that were completed for this SOW and for future reference.

UFS Scope

- Address May 30, 2019 PUC Order, GPA Docket 19-04, Guam Power Authority Request For Modification Of Current Net Metering Rider [NEM]

PUC Order Items (GPA Action Items)

PUC Order Item #	PUC Order Provision
6	GPA may petition the PUC for further changes to the NM Rider, including the rate of compensation paid to net metering customers, prior to the time at which the aggregate KW cap (10%) of the utility's system peak demand is met, but only if it has met all of the following preconditions
7	GPA is ordered to complete the planned distribution system impact study and include in that study a balanced locational and full benefit-cost analysis of how distributed generation impacts the distribution system.
8	GPA is ordered to include a rebate program for battery storage in the DSM program and encourage solar providers to include storage with the solar systems and explain the benefits to customers
9	If GPA is concerned about lost revenue, it should provide appropriate evidence during its next filed base rate case

Prerequisites for GPA to Petition (Item #6)

- GPA may petition the PUC for further changes to the NM Rider, including the rate of compensation paid to net metering customers, prior to the time at which the aggregate KW cap (10%) of the utility's system peak demand is met, but only if it has met all of the following preconditions:
    1. The distribution system impact study which GPA has already planned shall be completed;
    2. GPA shall have conducted and completed a full, balanced benefit-cost analysis that analyzes all of the impacts distributed generation has on the distribution system, especially specific to the location of the distributed generation on the system;
    3. A third-party consultant, undertakes and completes an independent study determining the cost of grid and other services used by NEM customers and which identifies, in detail, the specific value of those services to the NEM customers.
    4. The studies referenced in (2) and (3) above shall only be undertaken upon joint approval of the PUC and GP A, and shall be undertaken at the expense of GP A

PUC Order

- Item #7 covered under item #6 (Repeated text within item #6)
- GPA is ordered to include a rebate program for battery storage in the DSM program and encourage solar providers to include storage with the solar systems and explain the benefits to customers (Item #8);
- If GPA is concerned about lost revenue, it should provide appropriate evidence during its next filed base rate case (Item #9).

Distribution Study Tasks Mapped to PUC Order

Priority	Tasks	May 30, 2019 PUC Order Item			
		Item #6	Item #7	Item #8	Item #9
1	One (1) AGA System Assessment	x			
2	Distribution Model Corrections Study (via AGA Network Model Validator)	x			
3	Load Flow Studies (via AGA Asset Loading)	x	x		x
4	Distributed Renewable Energy Intermittency and Voltage Issue Elimination/Management Study (via AGA Planning Case Studies)	x	x		x
5	System Wide Voltage Analysis Study (via AGA Voltage Visualization)	x	x		x
6	Volt/VAR Optimization Study (via AGA Planning Case Studies)	x			x
7	Conservation Voltage Reduction Study (via AGA Capacity Contribution as well as Voltage Visualization and Planning Case Studies)	x			x
8	Demand Response Study (via AGA Capacity Contribution and Planning Case Studies)	x	x	x	x
9	Automated Switching and Communicating Fault Circuit Indicator Study (via GIS model analysis)				x
10	One (1) electronic document that catalogs all distribution design studies that were completed for this SOW and for future reference.	x	x	x	x

UFS versus L+G Distribution Study Scope

- General outputs that UFS would like to see from the engineering study:
  1. Capital improvement plan as detailed as possible for next 1 – 5 years or longer.
  2. Identify specific improvement, asset type, reason for needed improvement, asset cost, expected year(s) when money will be spent
- Distribution Study will at a minimum identify:
  1. Multi-pronged approach to address underfrequency load shedding events.
  2. Multi-pronged approach to smooth generation and load. (“flatten the curves”)
  3. Multi-pronged approach to meet the carbon neutral / carbon free plans for GPA.
     - Suggest adopting GPA Carbon goals of 50% Reduction in CO@ emissions from 2020 levels by 2035.
  4. Most of these are addressed in Renewable Integration Study at the Transmission Level.
- UFS will need to spend some more time refining inputs and outputs and UFS points of involvement throughout the engineering study

UFS Recommendations for Initial Study

UFS Recommendations on Engineering Feeder Study			Substation
Feeder	**UFS Notes**	**UFS Priority**	
P-220	Has larger array installed; Has higher total Solar PV installed	1	Apra
P-322	Has high total solar PV (small max feeder)	2	Pagat
P-087	Has larger array installed; Has highest penetration total Solar PV KW installed	3	Dededo
P-401	Has highest average sized solar PV installed (multiple 100 KW systems)	4	San Vitores

Distribution Study

- L+G Contract based on Investigating Distribution System on a Substation basis. (Phase I: 21 Feeders)

Substations	Apra	Pagat	Dededo *	San Vitores	Yigo*	Harmon
Feeders	P-220	P-321	P-87	P-400	P-330	P-046
	P-221	P-322	P-88	P-401	P-331	P-047
	P-222	P-323	P-89	P-402	P-332	P-111
	P-223			P-403		P-112

* Dededo & Yigo Feeders are the fastest NEM growth feeders.

RED Text Feeders chosen specifically for NEM Rate Study

Time Frame for Distribution Study

- For each substation analysis, the various tasks from end-to–end will take five months or less: June 30, 2021
- GPA & L+G will perform the substation analysis tasks in parallel for all substations

Ad Hoc Distribution Planning Scope

- The Ad Hoc Distribution Planning Scope includes analysis and planning for:
  - Distribution System Losses and Unaccounted-for Energy (UFA);
  - Distribution Automation (DA);
  - Microgrids.

System Losses and Unaccounted-for Energy (UFA)

- In 2010, the PUC approved GPA's Quality Management Plan for Cost Effective Reduction of System Losses and Unaccounted for Energy
- This plan recommended creating a metering network to trace system power at several key points:
  A. Generator-Side of Generator Transformer
  B. 13.8 KV side of the Substation Transfomers into the Distribution System
  C. Customer Meter
- A – B = Transmission System Losses
- B – C = Distribution System Losses
- Without this system, GPA depends on Accounting Billing Information to compute System Losses. Accounting Billing Data is not accurate enough for Energy Losses Accounting because for a number of reasons.
- GPA now has very accurate data to better allocate resources to reduce system losses and verify that its loss reduction measures are effective

Distribution Automation

- Umatac Poletop Recloser Pilot Project
  - Problematic circuit experiencing numerous outages
  - GPA placed the Umatac recloser under SCADA remote control using GPA's wireless mesh network
  - Reduces most outages from one hour or more to five minutes
- Current focus is extending control to poletop reclosers
- Future projects
  - Extend remote control capability to poletop and vault switches, street light controllers, distribution transformer monitoring
- Smart Grid systems installed under GPA's ARRA grant significantly reduce costs to implement distribution automation.

Recloser Automation Projects

POLE#	ISOLATION SWITCH PAIR	POLE#	FEEDER 1	FEEDER 2	INSTALL DATE	SYSTEM DATE*
27002	13-341A	26853	P-341	P-341	7/1/2019	3/9/2021
39572	13-223A	SAME	P-223	P-341	12/15/2020	3/9/2021
37559	13-261	37560	P-261	P-261	8/3/2020	3/9/2021
	13-090		P-260	P-220	PENDING	
24260	13-210A	SAME	P-211	P-250	11/10/2020	3/9/2021
46340	13-320T332	SAME	P-332	P-320	2/19/2021	3/9/2021
	13-301	39178	P-301	P-262	PENDING	3/9/2021
	13-202A		P-202	P-251	PENDING	3/9/2021
	13-212		P-212	P-253	PENDING	3/9/2021

Microgrids

- GPA has performed the preliminary scoping and planning for several microgrids:
  - Phase III Renewable Acquisition Multi-Step Bid
    - Naval Base Guam (NBG)
    - South Finegayan
  - Umatac Substation
  - Talofofo Substation
  - Apra Substation.
  - North-Central Guam Microgrid

L+G Scope of Work

- We verifying system information to get the most accurate model of the distribution system.
- AGA gets its model configuration from the GPA GIS system. AGA checks if there are issues with the GIS model and suggests corrections based on metering data. For example, AGA can tell us if a customer is wrongly assigned to a particular transformer and the correct transformer the customer is on.
- L+G remarked, in their experience, that GPA's GIS is already more accurate than the GIS of most of their clients prior to model verification.

AGA Results

Using meter voltage data and the AGA Meter Voltage module (with range and advanced filtering) we have found GWA facilities that have had at least one low voltage interval (90%-95% of nominal) for at 30 days of the last quarter

Meter	Service Location	Transformer	Feeder	Substation	Lowest Voltage	Lowest Voltage%	Lowest Voltage Date	Day Count
25000074	98328	17117	P-087	DEDEDO	450.62	93.88	24 Jan 2021	80
36000250	124112	32620	P-089	DEDEDO	260.22	93.94	24 Jan 2021	71
5000108	100630	9151	P-330	YIGO	451.42	94.05	22 Mar 2021	54

AGA Results

Using meter voltage data and the AGA Meter Voltage module (with range and advanced filtering) we have found customers that have had at least one low voltage interval (90%-95% of nominal) for at 30 days of the last quarter

Meter	Service Location	Transformer	Feeder	Substation	Lowest Voltage	Lowest Voltage%	Lowest Voltage Date	Day Count
2017902	100529	9302	P-330	YIGO	216.18	90.07	16 Jan 2021	76
2361472	126222	9533	P-330	YIGO	216.75	90.31	22 Mar 2021	77
2364896	100582	9302	P-330	YIGO	217.88	90.79	22 Mar 2021	76
2015292	101358	9790	P-330	YIGO	218.45	91.02	22 Mar 2021	74
2015294	101370	9790	P-330	YIGO	218.6	91.08	22 Mar 2021	74
2014779	128149	17241	P-330	YIGO	219.38	91.41	16 Feb 2021	44
2015267	101343	9790	P-330	YIGO	218.74	91.14	22 Mar 2021	70
2000436	98234	30186	P-330	YIGO	219.88	91.61	19 Feb 2021	41
2361032	127236	17241	P-330	YIGO	221.65	92.36	16 Feb 2021	37
2803857	101493	9557	P-330	YIGO	221.65	92.36	30 Jan 2021	30
2016265	104377	30175	P-330	YIGO	223	92.92	19 Feb 2021	58
2015265	101339	9790	P-330	YIGO	223	92.92	21 Mar 2021	43
2006019	103942	17236	P-330	YIGO	225.92	94.13	18 Jan 2021	31
2802658	103941	17236	P-330	YIGO	226.06	94.19	18 Jan 2021	31

Drilling down we can find that the highlighted meters on transformer 17236 have ~20% of their intervals below 95% of nominal (224V / 240V) for the 1st quarter.

In addition we can find that there are only these two meters are assigned to this transformer. This may leave room to change the tap on the transformer

Questions?