



U.S. Department of Energy  
Energy Efficiency and Renewable Energy

# Enhancing Monitoring and Reporting of Residential Renewable Energy Systems on the Navajo Nation

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,  
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# Navajo Tribal Utility Authority



To be a leader within Indian Country in:

- Renewable energy through creative, state-of-the-art construction designs and legislation, working together with Navajo Nation citizens, government, business, and private & public educational groups
- Creating positive relationships to renewable energy issues



# NTUA Off-Grid Electrification

- 1998 - 240/260 Watt PV Systems (40)
- 2001 - 640 Watt PV Systems (200)
- 2003 - 880 Watt Hybrid Systems (44) (Phase I)\*
- 2004 - 880 Watt Hybrid Systems (63) (Phase II)\*

\*enabled with Data Acquisition System (DAS)



## Monument Valley, UT

# NTUA Installations



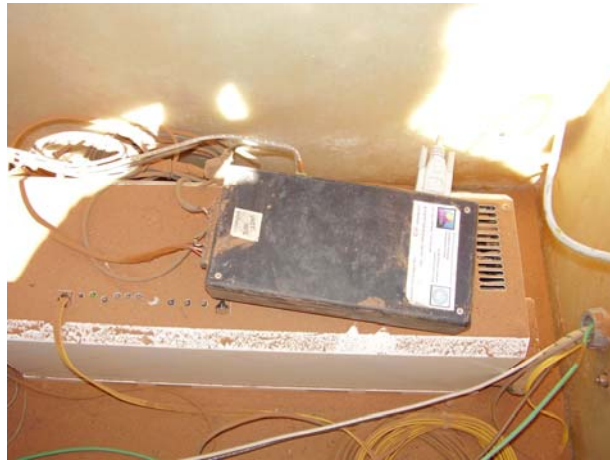
## Klagetoh, AZ



## Goulding Trading Post, UT



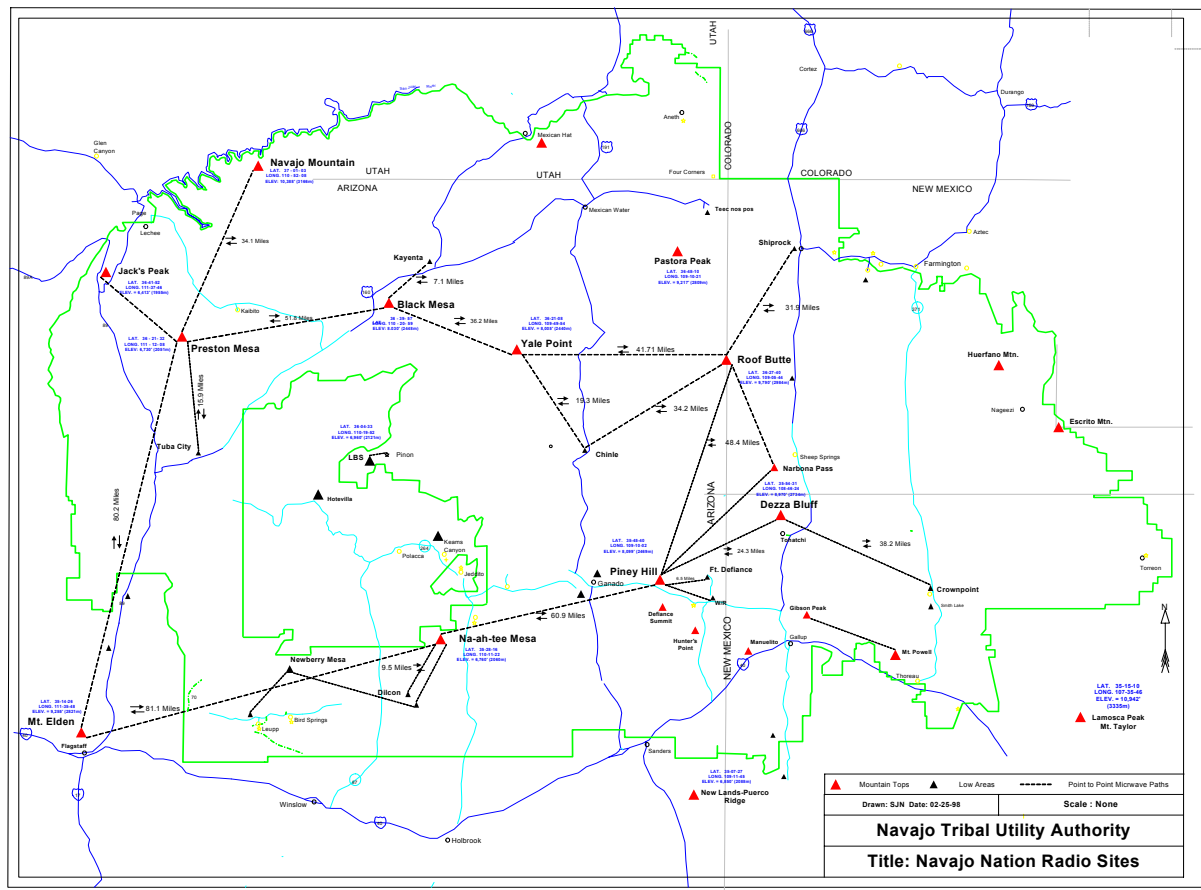
# Current DAS Retrieval



Manual - On-Site - Real Time Information



# NTUA Communication Infrastructure





# Raw DAS Output: Flat File

2006,72,100,	24.57,	-160.48,	0.21,	160.68,	1.21,	24.59,	24.34,	-100.00,	-160.48
2006,72,200,	24.48,	-160.48,	0.22,	160.68,	1.10,	24.53,	24.31,	-100.00,	-160.48
2006,72,300,	24.43,	-160.48,	0.22,	160.69,	0.92,	24.51,	24.24,	-100.00,	-160.48
2006,72,400,	24.44,	-160.48,	0.21,	160.68,	0.76,	24.46,	24.42,	-100.00,	-160.48
2006,72,500,	24.34,	-160.48,	0.22,	160.69,	0.74,	24.42,	24.16,	-100.00,	-160.48
2006,72,600,	24.33,	-160.48,	0.23,	160.70,	0.65,	24.37,	24.07,	-100.00,	-160.48
2006,72,700,	24.27,	-160.48,	0.23,	160.70,	0.37,	24.31,	24.07,	-100.00,	-160.48
2006,72,800,	24.23,	-160.48,	0.32,	160.79,	0.21,	24.28,	24.14,	-100.00,	-160.48
2006,72,900,	24.45,	-160.48,	1.74,	162.21,	0.31,	24.72,	24.28,	-100.00,	-160.48
2006,72,1000,	25.33,	-160.48,	6.22,	166.69,	0.86,	25.82,	24.72,	-100.00,	-160.48
2006,72,1100,	25.87,	-160.45,	10.04,	170.49,	2.04,	26.32,	25.59,	-100.00,	-160.48
2006,72,1200,	25.90,	-160.44,	9.16,	169.60,	2.60,	26.42,	25.75,	-100.00,	-160.45
2006,72,1300,	26.14,	-160.45,	11.41,	171.86,	2.95,	27.13,	25.79,	-100.00,	-160.46
2006,72,1400,	26.55,	-160.44,	15.20,	175.64,	3.64,	27.30,	25.83,	-100.00,	-160.45
2006,72,1500,	27.23,	-160.42,	20.25,	180.66,	4.83,	27.57,	26.26,	-100.00,	-160.44
2006,72,1600,	25.87,	-160.41,	5.31,	165.72,	5.23,	27.14,	25.72,	-100.00,	-160.42
2006,72,1700,	26.31,	-160.42,	8.81,	169.23,	5.13,	27.37,	25.72,	-100.00,	-160.43
2006,72,1800,	26.04,	-160.43,	9.33,	169.76,	5.56,	27.14,	25.42,	-100.00,	-160.43
2006,72,1900,	25.63,	-160.43,	5.22,	165.65,	5.94,	26.17,	24.94,	-100.00,	-160.44
2006,72,2000,	24.91,	-160.45,	0.33,	160.78,	5.55,	24.99,	24.79,	-100.00,	-160.46
2006,72,2100,	24.67,	-160.46,	0.20,	160.67,	4.43,	24.80,	24.56,	-100.00,	-160.47
2006,72,2200,	24.56,	-160.46,	0.21,	160.68,	4.01,	24.65,	24.43,	-100.00,	-160.47
2006,72,2300,	24.58,	-160.47,	0.21,	160.68,	3.66,	24.65,	24.42,	-100.00,	-160.47
2006,72,2400,	24.60,	-160.48,	0.21,	160.68,	3.32,	24.69,	24.41,	-100.00,	-160.47



# Formatted DAS Data – Excel Format

Year	Jda	Time	Vbat	Ibat	IPV	Iload	Tbat	VBatMax	VBatMin	IBatMax	IBatMin
2006	72	100	24.57	-160.48	0.21	160.68	1.21	24.59	24.34	-100	-160.48
2006	72	200	24.48	-160.48	0.22	160.68	1.1	24.53	24.31	-100	-160.48
2006	72	300	24.43	-160.48	0.22	160.69	0.92	24.51	24.24	-100	-160.48



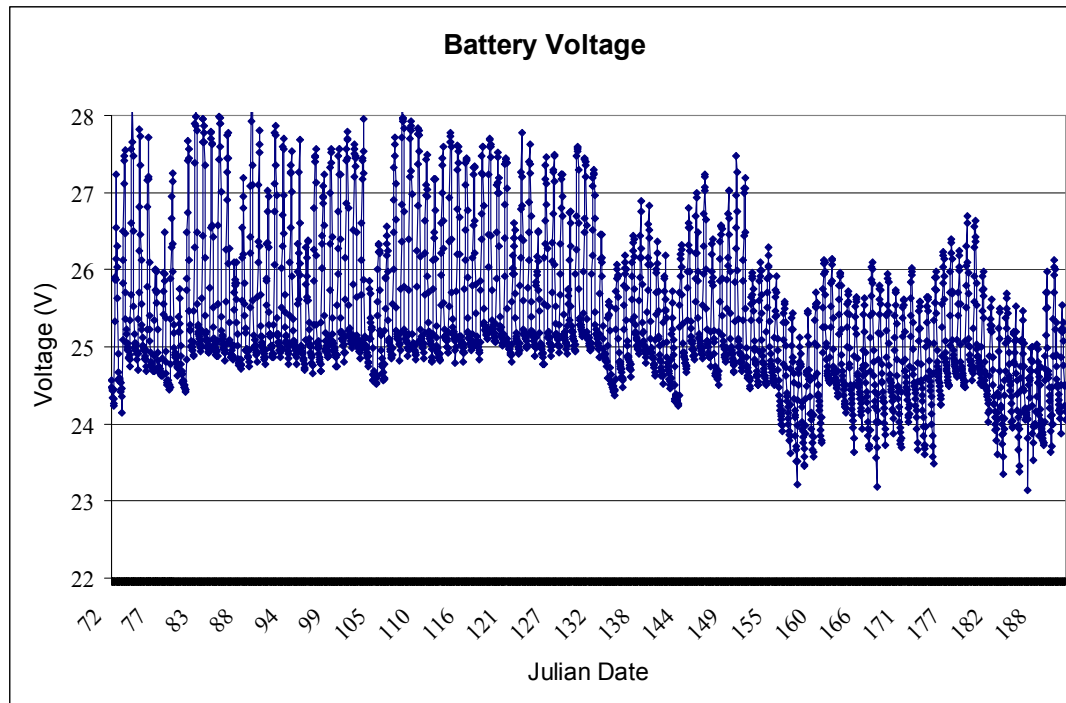


# DAS Data Legend

- Twelve fields per record
  - 1) Year
  - 2) Julian Day
  - 3) Time
  - 4) Average Vbat
  - 5) Average Ibat
  - 6) Average Ipv
  - 7) Average Iload
  - 8) Average Tbat
  - 9) Maximum Vbat
  - 10) Minimum Vbat
  - 11) Maximum Ibat
  - 12) Minimum Ibat

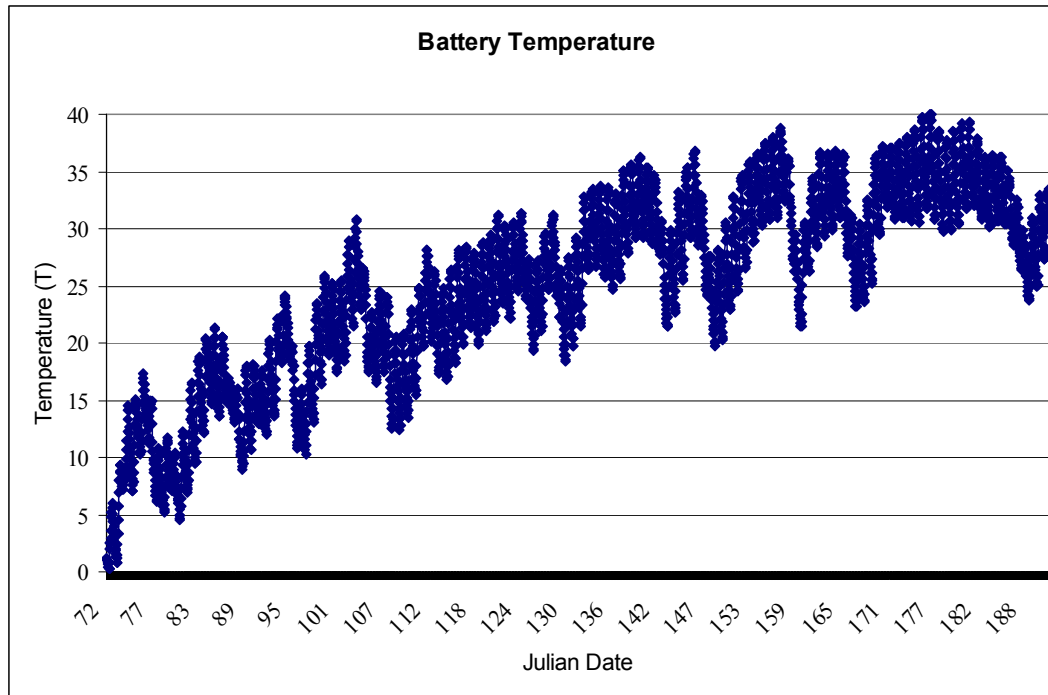


# 4) Avg Vbat





# 8) T<sub>bat</sub>





# Project Plan

- Integrate Polling with Existing Infrastructure
  - Communication Team to research/implement
  - SCADA Team has on-hold
  - Renewable Energy Team commitment to fund
- Second Option: Erect Dedicated Polling System -- tie in to Infrastructure
  - Communications/SCADA to consider after First Option failure
- Satellite Communication is not an option



# Internship Experience

- Excellent Learning Experience Matched to Academic Interest
- Opportunity to work with Commercial, Federal and Tribal Entities
- Interdisciplinary Opportunity
- Contribution to a Real-World Solution for Tribes



# Special Thanks!

- Sandra Begay-Campbell
- Deborah Tewa
- Tanya Martinez
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- Stephen Nez
- Marvin Jones