CRWMS/M&O

Design Analysis Cover Sheet

Complete only applicable items.

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QA: N/A

Page: 1

Of: 6

2. DESIGN ANALYSIS TITLE			
Standby Generators for North Portal Electrical Loads (SCPBIN/A)			
3. DOCUMENT IDENTIFIER (Including Rev. No.)		4. REV. NO.	5. TOTAL PAGES
BAB000000-01717-0200-00145-REV 00		00	6
6. TOTAL ATTACHMENTS	7. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH		8. SYSTEM ELEMENT
2	Att. I-15; II-4		ESF
	Print Name	Signature	Date
9. Originator	Y.D. SHANE	<i>Y.D. Shane</i>	3/31/95
10. Checker	BHARAT MAJUMDAR	<i>Bharat Majumdar</i>	3/31/95
11. Lead Design Engineer	BOB HOWELL	<i>Bharat Majumdar for Bob Howell</i>	3/31/95
12. QA Manager	D. M. Jenkins	<i>DM Jenkins</i>	03.31.95
13. Department Manager	G.N. Kimura	<i>G.N. Kimura</i>	3/31/95
14. REMARKS			

Design Analysis Revision Record

Complete only applicable items.

①

QA: N/A

Page: 2

Of: 6

2. DESIGN ANALYSIS TITLE		
Standby Generators for North Portal Electrical Loads		
3. DOCUMENT IDENTIFIER (Including Rev. No.)		4. REVISION NO.
BAB000000-01717-0200-00145 REV 00		00
5. Revision No.	6. Total Pages	7. Description of Revision
00		Initial Issue

1. PURPOSE

The purpose and objective of this design analysis is to establish the best and most economical way to provide standby power generation required for the North Portal loads. This analysis calculates the size and number of the new standby generators that will supplement the already-specified four 500 kW diesel generator units (7007-GN-401, -402, -403, and -404).

2. QUALITY ASSURANCE

- 2.1 No quality assurance (QA) controls apply to the items and activities as they are discussed within this analysis and it is therefore QA classified as "NONE" per [Quality Administrative Procedure] QAP-2-0 Rev. 1, QAP-2-3 Rev. 6, and [Implementing Line Procedure] NLP-3-18 Rev. 2.
- 2.2 No applicable Determination of Importance Evaluations (DIEs) (Reference 5.9) have resulted in controls that would affect the structures, systems, or components/configuration items described within this analysis. If a subsequent DIE indicates that the information provided in this analysis is required for use as a design input, this design analysis will require revision.
- 2.3 This study was prepared in accordance with QAP-3-9 Rev. 5.

3. METHOD

- 3.1 Review Design Analysis BABBDA000-01717-0200-00004 for type of loads requiring standby power backup.
- 3.2 Review Design Analysis BAB000000-01717-0200-00144 for the latest load summary including total standby power requirements.
- 3.3 Size standby generators required to satisfy North Portal loads based on the two design analyses listed above.
- 3.4 Perform load flow calculations to verify the ability of the standby generation system to start the largest motor loads.
- 3.5 Review Value Engineering Study VE-4 (North Portal diesel generators) performed August 15 through 18, 1994, for recommendations to satisfy standby power needs.

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

- 4.1.1 Loads requiring standby power back-up = 3156 kVA, Reference 5.1

- 4.1.2 Specified standby generators capacity = 2500 kVA, Reference 5.4
- 4.1.3 Add 20% for future and unforeseen loads, Reference 5.8
- 4.1.4 Standard standby generator size = 1375 kVA, Reference 5.6
- 4.1.5 Based on a power factor of 0.8 (Reference 5.6) for the standby generators, 1 kVA = 1.25 kW.

4.2 CRITERIA

In the event of a power outage, the standby power system shall provide all necessary power to systems and subsystems that are required to meet safety, operational, or security requirements for the construction and operation of the Exploratory Studies Facility (ESF). This standby requirement includes those systems essential to evacuation, fire control, flood control, and critical in situ site characterization testing (Reference 5.7).

4.3 ASSUMPTIONS

- 4.3.1 Standby generators will be used to provide power to the selected loads during normal utility power outage. These selected loads are identified as "standby" on the Canyon Substation Electrical Load Study (Reference 5.1).
- 4.3.2 On loss of normal utility power, buildings that do not have need for standby power, such as the Shop Building, will be disconnected from the power source via circuit breaker shunt trip to prevent overloading of the standby generators.
- 4.3.3 Starting of the Subsurface Ventilation Fans (250 HP at 480 V) on standby power will be controlled by a Programmable Logic Controller (PLC). Starting of the fans will be sequential to limit voltage drop on the standby power system. The PLC will limit starting of the fans to one fan every five to ten seconds with farthest fan starting first.
- 4.3.4 The new generators will operate in parallel with each other and the four refurbished 500 kW generators, and may be paralleled with the utility power for a short period of time to allow the retransfer of electrical loads to normal power source after restoration of the utility power.
- 4.3.5 Paralleling of standby generators with off-site utility power may require approval of the Nevada Test Site (NTS) Power Group, Nevada Power Company, and Valley Electric. Utility companies need to be aware of any generating systems that are paralleled with their system.

4.4 CODES AND STANDARDS

Not applicable.

5. REFERENCES

- 5.1 BAB000000-01717-0200-00144 Rev. 00, Canyon Substation Feed to North Portal Electrical Load Analysis.
- 5.2 BABB000000-01717-2100-24037 Rev. 00, Electrical Standby Power System One Line Diagram.
- 5.3 BABBDA000-01717-0200-00004 Rev. 0, ESF Analysis of Standby Power Requirements.
- 5.4 BABBDA000-01717-6300-16622 Rev. 00, Packaged Engine Generator Systems Specification.
- 5.5 Value Engineering Study VE-4 (LV.SES.LDF/JLR.8/94-013, August 31, 1994), North Portal Diesel Generators, August 15-18, 1994.
- 5.6 Onan Power Systems Manual (Diesel engine generator manufacturer catalog data, 10/94).
- 5.7 YMP/CM-0019, Rev. 0, Exploratory Studies Facility Design Requirements (ESFDR)
- 5.8 Institute of Electrical and Electronics Engineers (IEEE) Standard 141-1986, Section 2.2.9, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
- 5.9 BABB000000-01717-2200-00001, Rev. 05, DIE for ESF North Portal Pad

6. USE OF COMPUTER SOFTWARE

Electrical Transient Analysis Program (ETAP) by Operation Technology, Inc. (OTI) Version 6.52 was used to verify motor starting capability of the standby power generation system. The software used was appropriate for the nonquality affecting application.

7. DESIGN ANALYSIS

- 7.1 The Design Analysis BABBDA000-01717-0200-00004 (Reference 5.3) established the requirement for standby power. As a result, four NTS surplus diesel engine generator sets, 500 kW each, were specified to be refurbished to meet the standby power requirement of 2015 kVA (1612 kW), Reference 5.4.
- 7.2 The subsequent Design Analysis BAB000000-01717-0200-00144 identified additional loads requiring standby power such as subsurface ventilation fans and the electric trolley. This analysis calculated the total standby loads to be 3156 kVA.
- 7.3 By adding 20 percent (Reference 4.1.3) to the above number, the total standby generation system should be sized at approximately 3787 kVA. The already-specified standby generators add up to 2500 kVA. Therefore, the new standby generator should be sized at

approximately 1287 kVA (1030 kW). The next standard size for diesel generator unit rated for standby duty is 1375 kVA (1100 kW).

- 7.4 Motor starting analysis was performed to verify motor starting capability of the overall standby generating system. The results are satisfactory with the worst case scenario being 8.58 percent voltage dip during starting of the farthest 250 HP ventilation fan. (See Attachment I.)

8. CONCLUSIONS

- 8.1 Two new standby diesel generator units, 1100 kW each, will be specified to satisfy the standby power requirements for the North Portal standby loads. Only one new unit will be required to operate during normal power outage. The second unit will be used as a standby spare to any diesel generator that is being repaired or is out for a scheduled maintenance service.
- 8.2 The worst case fuel consumption will occur when two 1100 kW and three 500 kW generator units operate simultaneously at full load. This fuel supply system shall be sized based on this scenario.
- 8.3 This Design Analysis is in agreement with the Value Engineering Study not to refurbish Kelly Air Force Base generators since it is the most expensive way to provide additional required standby power. Refurbishment of the low-speed Kelly Air Force Base generators was based on a previous issue of the electrical load study, which indicated the need for the diesel generators to supplement normal utility power. A budgetary estimate at that time indicated that it would be cost-effective to refurbish Kelly Air Force Base generators if they were used 24 hours a day to supplement normal utility power over a one-year period, based on higher efficiency, lower maintenance, and lower fuel consumption of the low-speed versus high-speed generators. The Electrical Load Study used in this Design Analysis no longer requires diesel generators to supplement the normal utility power; therefore, there is no monetary advantage to refurbish the Kelly Air Force Base diesel generators.

9. ATTACHMENTS

ATTACHMENT	TITLE	PAGES
I	ETAP Motor Starting Analysis	15
II	Executive Summary Power Distribution VE Study, August 15-18, 1994, North and South Portals and Surface Testing	4

SURFACE LOADS

SWITCHGEAR BUILDING:

Lighting and receptacles	32 kVA
HVAC	82 kVA
Site communications system	72 kVA
IDCS	45 kVA

CHANGE HOUSE BUILDING:

Lighting and receptacles	39 kVA
HVAC	60 kVA
Security system (Site)	5 kVA

SURFACE MUCK CONVEYOR

Lighting	5 kVA
----------	-------

AIR COMPRESSORS:

Lighting	1 kVA
Air compressor No. 2	360 kVA

Subtotal 701 kVA

SUBSURFACE LOADS

Tunnel lighting & lighting poles		5 kVA
Ventilation Fans	8 @ 250kVA	2000 kVA
Electric Trolley		170 kVA
480V Panels(Ltg./ Recept./ Test)	11 @ 22.5kVA	248 kVA
120V Panels (Recept. / Test)	11 @ 15kVA	165 kVA

Subtotal 2588 kVA

TOTAL 3289 kVA

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

SYSTEM ANALYSIS

ETAP 6.52

Study Case:

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 File: POWER2

MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Electrical Transient Analyzer Program

MOTOR STARTING ANALYSIS

Quick Design - Snapshot

	Swing	Gen.	Load	Total
Number of Buses:	1	5	22	28

	XFRM	React.	Line	Imp.	C.B.	Total
Number of Branches:	4	0	23	0	0	27

	Synch. Gen.	Synch. Motor	Ind. Motor	Uti- lity	Total
Number of Machines:	6	0	0	0	6

Maximum Number of Iterations: 10

Precision of the Solution: .00100 MW and Mvar

Method of Solution: Newton-Raphson

System Frequency: 60.0 Hz

Unit System: English

Data Filename: POWER2

Output Filename: MOTST-1

BUS INPUT DATA

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

ETAP 6.52

Study Case:

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 Date: 01-23-1995
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 File: POWER2

MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus Information & Base kV				Init.Voltage		Generation		MTR Load @ T=0-		Static Load		Mvar Limits	
No.	Name	Type	kV	Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Max.	Min.
2	MAINSWGR	Load	12.47	100.0	.0			.000	.000	.000	.000		
3	SUBSURF1	Load	12.47	100.0	.0			.000	.000	.000	.000		
4	SUBSURF2	Load	12.47	100.0	.0			.000	.000	.000	.000		
6	PDMTSWGR	Load	12.47	100.0	.0			.000	.000	.000	.000		
7	GN-401	Gen.	4.16	100.0	.0	.500	.375	.000	.000	.000	.000	.375	.000
8	GN-402	Gen.	4.16	100.0	.0	.500	.375	.000	.000	.000	.000	.375	.000
9	GN-403	Gen.	4.16	100.0	.0	.500	.375	.000	.000	.000	.000	.375	.000
10	GN-404	Gen.	4.16	100.0	.0	.500	.375	.000	.000	.000	.000	.375	.000
11	4.16SWGR	SWGR	4.16	100.0	.0			.000	.000	.000	.000		
12	MUCKCONV	Load	4.16	100.0	.0			.000	.000	.005	.004		
13	COMPRESS	Load	4.16	100.0	.0			.288	.216	.000	.000		
14	PRSTEPUP	Load	4.16	100.0	.0			.000	.000	.000	.000		
15	SESTEPUP	Load	12.47	100.0	.0			.000	.000	.000	.000		
16	PRI.T1	Load	12.47	100.0	.0			.000	.000	.000	.000		
17	SEC.T1	Load	.48	100.0	.0			.000	.000	.000	.000		
24	PRI.T5	Load	12.47	100.0	.0			.000	.000	.000	.000		
25	SEC.T5	Load	.48	100.0	.0			.000	.000	.000	.000		
26	SWGRBLDG	Load	.48	100.0	.0			.074	.036	.119	.089		
30	CHNGEHSE	Load	.48	100.0	.0			.054	.026	.035	.026		
33	PRI T7	Load	12.47	100.0	.0			.000	.000	.000	.000		
35	PRI T8	Load	12.47	100.0	.0			.000	.000	.000	.000		
37	PRI T9	Load	12.47	100.0	.0			.000	.000	.000	.000		
39	PRI T10	Load	12.47	100.0	.0			.000	.000	.000	.000		
41	PRI T11	Load	12.47	100.0	.0			.000	.000	.000	.000		
43	PRI T12	Load	12.47	100.0	.0			.000	.000	.000	.000		
45	PRI T13	Load	12.47	100.0	.0			.000	.000	.000	.000		
46	VENTFAN8	Load	.48	100.0	.0			.000	.000	.003	.002		
47	GN-405	Gen.	4.16	100.0	.0	1.100	.825	.000	.000	.000	.000	.825	.000
28 Buses Total						3.100		.416	.278	.162	.121		

MTR load at T = 0- indicate the motor load on each bus prior to starting any motors.

LINE / CABLE DATA

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

ETAP 6.52

Study Case:

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

CKT #	CKT / Branch			Line / Cable (ohms/1000 ft per phase)								Impedance			
	From	To	Name	Library	Size	L (ft)	#/Y	T (°C)	R	X	Y	MVA _b	% R	% X	% Y
2	2	3	SUBSURF1	15NCOS1	750	675.	2	75	.02030	.03960	.000000	100.0	.44	.86	.000
3	2	4	SUBSURF2	15NCOS1	750	675.	2	75	.02030	.03960	.000000	100.0	.44	.86	.000
5	2	6	SWGRFDR	15NCOS1	500	180.	1	75	.02840	.04210	.000000	100.0	.33	.49	.000
6	7	11	GN-401	5NCOS1	2/0	215.	1	75	.10200	.05040	.000000	100.0	12.67	6.26	.000
7	8	11	GN-402	5NCOS1	2/0	235.	1	75	.10200	.05040	.000000	100.0	13.85	6.84	.000
8	9	11	GN-403	5NCOS1	2/0	235.	1	75	.10200	.05040	.000000	100.0	13.85	6.84	.000
9	10	11	GN-404	5NCOS1	2/0	275.	1	75	.10200	.05040	.000000	100.0	16.21	8.01	.000
10	11	12	MUCKCONV	5NCOS1	2/0	400.	1	75	.10200	.05040	.000000	100.0	23.58	11.65	.000
11	11	13	COMPRESS	5NCOS1	500	190.	1	75	.02840	.04210	.000000	100.0	3.12	4.62	.000
12	11	14	PRSTEPUP	5NCOS1	750	90.	1	75	.02030	.03960	.000000	100.0	1.06	2.06	.000
14	15	6	PDMTSWGR	15NCOS1	500	255.	1	75	.02840	.04210	.000000	100.0	.47	.69	.000
15	6	16	PRI.T1	15NCOS1	500	185.	1	75	.02840	.04210	.000000	100.0	.34	.50	.000
17	17	26	SWGRBLDG	1NCON1	500	60.	6	75	.02760	.03930	.000000	100.0	11.98	17.06	.000
18	6	24	PRI.T5	15NCOS1	500	700.	1	75	.02840	.04210	.000000	100.0	1.28	1.90	.000
29	25	30	CHNGHSE	1NCON1	500	60.	4	75	.02760	.03930	.000000	100.0	17.97	25.59	.000
33	3	33	MVSWGR	15NCOS3	500	200.	2	75	.02840	.03510	.000000	100.0	.18	.23	.000
41	11	47	GN-405	5NCOS3	4/0	300.	1	75	.06400	.03890	.000000	100.0	11.09	6.74	.000
43	33	35	T7-T8	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000
44	35	37	T8-T9	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000
45	37	39	T9-T10	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000
46	39	41	T10-T11	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000
47	41	43	T11-T12	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000
48	43	45	T12-T13	15NCOS3	500	3400.	2	75	.02840	.03510	.000000	100.0	3.10	3.84	.000

Line / Cable resistances are listed at the specified temperatures.

XFMR / REACTOR DATA

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

ETAP 6.52

Study Case:

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 File: POWER2

MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

CKT #	CKT / Branch			Transformer				Reactor		Impedance (100 MVA Base)		
	From	To	Name	MVA	% Z	X/R	% Tap	X (ohm)	X/R	%Tolerance	% R	% X
13	14	15	STEPXFMR	5.000	7.500	12.1	.000			7.50	13.2	160.7
16	16	17	XFMR-T1	.750	5.500	5.8	.000			7.50	134.2	776.8
26	24	25	XFMR-T5	.500	5.500	5.8	.000			7.50	201.3	1165.2
40	45	46	XFMR-T13	.750	5.500	5.8	-2.500			7.50	134.2	776.8

MACHINE INPUT DATA

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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 Date: 01-23-1995
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 File: POWER2

MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus No.	Machine Information			Rating (Base)		Machine Impedance			Machine Loading			
	No.	Name	Type	kV	MVA	% R	% X ^{II}	% X ^I *	% Bus P	% Bus Q	MW	Mvar
10	100	GN-404	Syn. Gen.	4.16	.625	.86	18.00	25.00	100.0	100.0	.500	.375
7	107	GN-401	Syn. Gen.	4.16	.625	.86	18.00	25.00	100.0	100.0	.500	.375
8	108	GN-402	Syn. Gen.	4.16	.625	.86	18.00	25.00	100.0	100.0	.500	.375
9	109	GN-403	Syn. Gen.	4.16	.625	.86	18.00	25.00	100.0	100.0	.500	.375
11	111	4.16SWGR	Syn. Gen.	4.16	3.875	.60	18.00	25.00	100.0	100.0	-2.527	.403
47	147	GN-405	Syn. Gen.	4.16	1.375	.74	18.00	25.00	100.0	100.0	1.100	.825
Total Connected Generators (= 6):					7.750							

* Indicates the reactance used for machine representation.

LOAD FLOW @ T = 0-

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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Study Case:

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 Date: 01-23-1995
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 File: POWER2

MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	XPF	% Tap
2	MAINSWGR	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	2	3	.00	.00	0.	60.8	
												2	4	.00	.00	0.	.0	
												2	6	.00	.00	0.	57.2	
3	SUBSURF1	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	3	2	.00	.00	0.	60.8	
												3	33	.00	.00	0.	93.9	
4	SUBSURF2	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	4	2	.00	.00	0.	.0	
6	PDMTSWGR	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	6	2	.00	.00	0.	57.2	
												6	15	-.28	-.18	15.	83.9	
												6	16	.19	.13	11.	83.4	
												6	24	.09	.05	5.	85.8	
7	GN-401	Gen.	4.16	100.06	.0	.00	.00	.00	.00	.00	.00	7	11	.50	.00	69.	100.0	
												7	107	-.50	-.37	87.	80.0	
8	GN-402	Gen.	4.16	100.07	.0	.00	.00	.00	.00	.00	.00	8	11	.50	.00	69.	100.0	
												8	108	-.50	-.38	87.	80.0	
9	GN-403	Gen.	4.16	100.07	.0	.00	.00	.00	.00	.00	.00	9	11	.50	.00	69.	100.0	
												9	109	-.50	-.37	87.	80.0	
10	GN-404	Gen.	4.16	100.08	.0	.00	.00	.00	.00	.00	.00	10	11	.50	.00	69.	100.0	
												10	100	-.50	-.38	87.	80.0	
* 11	4.16SWGR	Utly	4.16	100.00	.0	.00	.00	.00	.00	.00	.00	11	7	-.50	.00	69.	-100.0	
												11	8	-.50	.00	69.	-100.0	
												11	9	-.50	.00	69.	-100.0	
												11	10	-.50	.00	69.	-100.0	
												11	12	.01	.00	1.	78.1	
												11	13	.29	.22	50.	80.0	
												11	14	.28	.18	46.	83.6	
												11	47	-1.10	.00	152.	-100.0	
												11	111	2.53	-.40	355.	-98.8	
12	MUCKCONV	Load	4.16	100.00	.0	.00	.00	.00	.00	.00	.00	12	11	-.01	.00	1.	78.1	
13	COMPRESS	Load	4.16	99.98	.0	.00	.00	.29	.22	.00	.00	13	11	-.29	-.22	50.	80.0	
14	PRSTEPUP	Load	4.16	99.99	.0	.00	.00	.00	.00	.00	.00	14	11	-.28	-.18	46.	83.6	
												14	15	.28	.18	46.	83.6	

* Constant voltage buses.

LOAD FLOW @ T = 0-

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

ETAP 6.52

Study Case:

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 Date: 01-23-1995
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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	XPF	% Tap
15	SESTEPUP	Load	12.47	99.67	-.2	.00	.00	.00	.00	.00	.00	15	6	.28	.18	15.	83.9	
												15	14	-.28	-.18	15.	83.8	
16	PRI.T1	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	16	6	-.19	-.13	11.	83.4	
												16	17	.19	.13	11.	83.3	
17	SEC.T1	Load	.480	98.43	-1.0	.00	.00	.00	.00	.00	.00	17	26	.19	.12	275.	84.0	
												17	16	-.19	-.12	275.	84.0	
24	PRI.T5	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	24	6	-.09	-.05	5.	85.8	
												24	25	.09	.05	5.	85.9	
25	SEC.T5	Load	.480	98.87	-.8	.00	.00	.00	.00	.00	.00	25	30	.09	.05	124.	86.4	
												25	24	-.09	-.05	124.	86.4	
26	SWGRBLDG	Load	.480	98.39	-1.0	.00	.00	.07	.04	.12	.09	26	17	-.19	-.12	275.	84.0	
30	CHNGEHSE	Load	.480	98.84	-.8	.00	.00	.05	.03	.03	.03	30	25	-.09	-.05	124.	86.4	
33	PRI T7	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	33	3	.00	.00	0.	93.9	
												33	35	.00	.00	0.	82.9	
35	PRI T8	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	35	33	.00	.00	0.	82.9	
												35	37	.00	.00	0.	83.4	
37	PRI T9	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	37	35	.00	.00	0.	83.4	
												37	39	.00	.00	0.	83.4	
39	PRI T10	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	39	37	.00	.00	0.	83.4	
												39	41	.00	.00	0.	83.9	
41	PRI T11	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	41	39	.00	.00	0.	83.9	
												41	43	.00	.00	0.	83.4	
43	PRI T12	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	43	41	.00	.00	0.	83.4	
												43	45	.00	.00	0.	83.0	
45	PRI T13	Load	12.47	99.66	-.2	.00	.00	.00	.00	.00	.00	45	43	.00	.00	0.	83.0	
												45	46	.00	.00	0.	83.2	-2.500
46	VENTFAN8	Load	.480	102.20	-.3	.00	.00	.00	.00	.00	.00	46	45	.00	.00	4.	83.2	2.500

* Constant voltage buses.

LOAD FLOW @ T = 0-

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	XPF	% Tap
47	GN-405	Gen.	4.16	100.12	.0	.00	.00	.00	.00	.00	.00	47	11	1.10	.00	152.	100.0	
												47	147	-1.10	-.82	191.	80.0	
*100	GN-404	SynG	4.16	117.38	9.6	.51	.53	.00	.00	.00	.00	100	10	.51	.53	87.	68.9	
*107	GN-401	SynG	4.16	117.37	9.6	.51	.53	.00	.00	.00	.00	107	7	.51	.53	87.	68.9	
*108	GN-402	SynG	4.16	117.37	9.6	.51	.53	.00	.00	.00	.00	108	8	.51	.53	87.	68.9	
*109	GN-403	SynG	4.16	117.37	9.6	.51	.53	.00	.00	.00	.00	109	9	.51	.53	87.	68.9	
*111	4.16SWGR	SynG	4.16	103.51	-9.1	-2.52	.83	.00	.00	.00	.00	111	11	-2.52	.83	355.	-95.0	
*147	GN-405	SynG	4.16	117.33	9.6	1.11	1.17	.00	.00	.00	.00	147	47	1.11	1.17	191.	68.9	

* Constant voltage buses.

LOAD FLOW @ T = 0+

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	%PF	% Tap
2	MAINSWGR	Load	12.47	101.07	-.9	.00	.00	.00	.00	.00	.00	2	3	.29	1.24	59.	22.5	
												2	4	.00	.00	0.	.0	
												2	6	-.29	-1.24	58.	22.4	
3	SUBSURF1	Load	12.47	101.06	-.9	.00	.00	.00	.00	.00	.00	3	2	-.29	-1.24	59.	22.5	
												3	33	.29	1.24	58.	22.5	
4	SUBSURF2	Load	12.47	101.07	-.9	.00	.00	.00	.00	.00	.00	4	2	.00	.00	0.	.0	
6	PONTSWGR	Load	12.47	101.08	-.9	.00	.00	.00	.00	.00	.00	6	2	.29	1.24	58.	22.4	
												6	15	-.57	-1.43	70.	37.0	
												6	16	.19	.13	11.	83.1	
												6	24	.09	.05	5.	85.9	
7	GN-401	Gen.	4.16	103.56	-.5	.00	.00	.00	.00	.00	.00	7	11	.54	.29	82.	88.0	
												7	107	-.54	-.29	82.	88.0	
8	GN-402	Gen.	4.16	103.57	-.5	.00	.00	.00	.00	.00	.00	8	11	.54	.29	82.	88.0	
												8	108	-.54	-.29	82.	88.0	
9	GN-403	Gen.	4.16	103.57	-.5	.00	.00	.00	.00	.00	.00	9	11	.54	.29	82.	88.0	
												9	109	-.54	-.29	82.	88.0	
10	GN-404	Gen.	4.16	103.58	-.5	.00	.00	.00	.00	.00	.00	10	11	.54	.29	82.	88.0	
												10	100	-.54	-.29	82.	88.0	
* 11	4.16SWGR	Utly	4.16	103.48	-.5	.00	.00	.00	.00	.00	.00	11	7	-.54	-.29	82.	88.0	
												11	8	-.54	-.29	82.	88.0	
												11	9	-.54	-.29	82.	88.0	
												11	10	-.54	-.29	82.	88.0	
												11	12	.01	.00	1.	78.0	
												11	13	.29	.22	48.	80.0	
												11	14	.57	1.47	211.	36.3	
												11	47	-1.19	-.64	181.	88.1	
												11	111	2.49	.12	334.	99.9	
12	MUCKCONV	Load	4.16	103.47	-.5	.00	.00	.00	.00	.01	.00	12	11	-.01	.00	1.	78.0	
13	COMPRESS	Load	4.16	103.46	-.5	.00	.00	.29	.22	.00	.00	13	11	-.29	-.22	48.	80.0	
14	PRSTEPUP	Load	4.16	103.44	-.5	.00	.00	.00	.00	.00	.00	14	11	-.57	-1.46	211.	36.3	
												14	15	.57	1.47	211.	36.3	

* Constant voltage buses.

LOAD FLOW @ T = 0+

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	XPF	% Tap
15	SESTEPUP	Load	12.47	101.09	-.9	.00	.00	.00	.00	.00	.00	15	6	.57	1.43	70.	37.0	
												15	14	-.57	-1.43	70.	37.0	
16	PRI.T1	Load	12.47	101.08	-.9	.00	.00	.00	.00	.00	.00	16	6	-.19	-.13	11.	83.1	
												16	17	.19	.13	11.	83.2	
17	SEC.T1	Load	.480	99.84	-1.6	.00	.00	.00	.00	.00	.00	17	26	.19	.12	276.	83.9	
												17	16	-.19	-.12	276.	83.9	
24	PRI.T5	Load	12.47	101.08	-.9	.00	.00	.00	.00	.00	.00	24	6	-.09	-.05	5.	85.9	
												24	25	.09	.05	5.	85.9	
25	SEC.T5	Load	.480	100.29	-1.4	.00	.00	.00	.00	.00	.00	25	30	.09	.05	124.	86.3	
												25	24	-.09	-.05	124.	86.3	
26	SMGRBLDG	Load	.480	99.80	-1.6	.00	.00	.07	.04	.12	.09	26	17	-.19	-.12	276.	83.9	
30	CHNGENSE	Load	.480	100.26	-1.4	.00	.00	.05	.03	.04	.03	30	25	-.09	-.05	124.	86.3	
33	PRI T7	Load	12.47	101.06	-.9	.00	.00	.00	.00	.00	.00	33	3	-.29	-1.24	58.	22.5	
												33	35	.29	1.24	58.	22.6	
35	PRI T8	Load	12.47	101.00	-.9	.00	.00	.00	.00	.00	.00	35	33	-.29	-1.24	58.	22.6	
												35	37	.29	1.24	58.	22.6	
37	PRI T9	Load	12.47	100.95	-.8	.00	.00	.00	.00	.00	.00	37	35	-.29	-1.24	58.	22.6	
												37	39	.29	1.24	58.	22.6	
39	PRI T10	Load	12.47	100.89	-.8	.00	.00	.00	.00	.00	.00	39	37	-.29	-1.24	58.	22.6	
												39	41	.29	1.24	58.	22.6	
41	PRI T11	Load	12.47	100.83	-.8	.00	.00	.00	.00	.00	.00	41	39	-.29	-1.24	58.	22.5	
												41	43	.29	1.24	58.	22.5	
43	PRI T12	Load	12.47	100.78	-.8	.00	.00	.00	.00	.00	.00	43	41	-.29	-1.24	58.	22.5	
												43	45	.29	1.24	58.	22.5	
45	PRI T13	Load	12.47	100.72	-.8	.00	.00	.00	.00	.00	.00	45	43	-.29	-1.24	58.	22.5	
												45	46	.29	1.24	58.	22.5	-2.500
46	VENTFAN8	Load	.480	93.62	-1.1	.00	.00	.00	.00	.27	1.12	46	45	-.27	-1.12	1480.	23.1	2.500

* Constant voltage buses.

LOAD FLOW @ T = 0+

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Bus / Machine Information				Voltage		Generation		Motor Load		Static Load		Load Flow						XFRM
No.	Name	Type	kV	% Mag.	Ang.	MW	Mvar	MW	Mvar	MW	Mvar	Bus	Bus	MW	Mvar	Amp	%PF	% Tap
47	GN-405	Gen.	4.16	103.65	-1.5	.00	.00	.00	.00	.00	.00	47	11	1.19	.64	181.	88.1	
												47	147	-1.19	-.64	181.	88.1	
*100	GN-404	SynG	4.16	117.38	9.6	.55	.43	.00	.00	.00	.00	100	10	.55	.43	82.	78.4	
*107	GN-401	SynG	4.16	117.37	9.6	.55	.43	.00	.00	.00	.00	107	7	.55	.43	82.	78.3	
*108	GN-402	SynG	4.16	117.37	9.6	.55	.43	.00	.00	.00	.00	108	8	.55	.43	82.	78.3	
*109	GN-403	SynG	4.16	117.37	9.6	.55	.43	.00	.00	.00	.00	109	9	.55	.43	82.	78.3	
*111	4.16SWGR	SynG	4.16	103.51	-9.1	-2.48	.25	.00	.00	.00	.00	111	11	-2.48	.25	334.	-99.5	
*147	GN-405	SynG	4.16	117.33	9.6	1.20	.95	.00	.00	.00	.00	147	47	1.20	.95	181.	78.4	

* Constant voltage buses.

MOTOR STARTING SUMM.

Project: YUCCA MOUNTAIN
 Location: LAS VEGAS, NV
 Contract: 80580825
 Engineer: B.MAJMUDAR

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MOTOR STARTING ANALYSIS
 Starting Vent Fan No.8

Motor Starting at Bus # 46 (VENTFAN8), a .48 kV Bus

MOTOR RATINGS		FULL LOAD (at motor rated kV)					LOCKED ROTOR (at motor rated kV)				
HP	kV	Amp	% PF	% Eff.	MW	Mvar	% FLA	Amp	% PF	MW	Mvar
250.	.48	263.0	91.8	92.9	.201	.0870	599.8	1577.8	22.9	.300	1.277

STARTING VALUES (at the starting kV)				
% FLA	Amp	% PF	MW	Mvar
561.6	1477.2	22.9	.263	1.119

MOTOR TERMINAL CONDITIONS:

	kV	System Base kVb = .48	Machine Base kVb = .48
Terminal Voltage before starting:	.491	102.20 %	102.20 %
Terminal Voltage at starting (0+):	.449	93.62 %	93.62 %
Voltage drop due to starting:	.041	8.58 %	8.58 %

Reduction in motor starting torque = 12.35 %

EXECUTIVE SUMMARY**POWER DISTRIBUTION VE STUDY, AUGUST 15-18, 1994
NORTH AND SOUTH PORTALS AND SURFACE TESTING**

The Value engineering study was conducted to identify the best method for feeding all the subject areas electrical loads listed in the load study; the best application of electrical distribution equipment; electrical loads at the south portal considering the current scenario; and the best application of diesel generators for both serving as standby and supplemental units for the Canyon substation feed to the north portal loads.

The study team was excellent. It had a great blend of expertise, innovation and camaraderie. The support was superb. The following people participated in the VE study total effort.

<u>VE Team Members</u>	<u>Organization</u>	<u>Telephone No.</u>
Hank Spieker	M&O/TRW	4-7558
Rodney Hearn	M&O/DUKE	4-1992
Bharat Majmudar	M&O/FD	4-1981
Edgar Eberhard	M&O/MK	4-7083
Terry Neisen	RSN	4-7083
Donald M. Bourcier	REECO	4-1982
William L. Kelly	VEST	(509)525-2866

Kickoff Meeting Attendees

Jim Leak	M&O/FD	4-7204
Brian Allen	M&O/FD	4-1987
R. E. Howell	M&O/DUKE	4-5395
Jim Gardiner	DOE	4-7583
Bill Reed	ESF Sub. Des.	4-5395

Some folks may be missed in this listing. If so, please accept our regrets and heartfelt thanks for your help at the same time.

Value Engineering follows a strict methodology, using specific techniques and multi-disciplined teams of folks. It is usually applied on an early concept. Appropriate plans and estimates are needed to determine cost/worth ratios. A baseline concept was not ready for much of the study areas. It seems baselines are evolutionary in nature. However, we had excellent talent and back-ground in the objectives and needs of the project and concepts both past and current to understand the goals of the designs.

Value Engineering is not a critical review, contractibility review, or cost cutting exercise. The latter is often resorted to when a VE team is admonished to slash costs by some percentage or amount. Panic sets in and meeting the cost reduction goal becomes all important. We follow the job plan and methodology precisely. If one has both faith and competence in the VE/VA process, success is assured. If people are allowed to think, savings become a by-product.

/

Value engineering/analysis is a problem solving technique that bypasses learned response to produce alternative solutions to satisfy all required functions of the original concept at the lowest life-cycle costs. If a team follows the methodology, it works.

All the work accomplished by the team means nothing unless recommendations are implemented. That is the responsibility of decision-makers. We have carefully and thoughtfully considered every aspect of our recommendations to ensure technical adequacy, life-cycle cost comparisons and savings to the taxpayer. Please examine the worksheets to understand the thoroughness of the process. We recommend the following alternatives for adoption:

**SURFACE BASED TESTING POWER SUPPLY: VE-1
FUNCTION: ROUTE POWER**

Install a power line loop that roughly encircles the most sensitive environmental zone by following existing roads and trails to the maximum. This option has the lowest life-cycle costs. Potential Savings: \$555,031 life-cycle costs.

**POWER SUPPLY TO OFF PLOT SITES. VE-2
FUNCTION: ROUTE POWER**

Connect the South portal using a 15KV overhead line from the North portal pad. Use 15KV tap to C-Well. Potential Savings: \$859,300.

**ELECTRICAL LOADS AT THE SOUTH PORTAL. (INCLUDED TO ANSWER THE REQUEST
CONTAINED IN THE TEAM BRIEFING DOCUMENT)
FUNCTION: SUPPORT ACTIVITIES**

The VE team reexamined the VE study on the Standby Power Generation (8/28-7/1 1993). We felt the estimated loads recommended by the study (2015KVA), plus tunnel ventilation (2250KVA) and electric drive units (800KVA) or about 5MVA would be sufficient for South portal loads. If an event occurs in the North portal of a magnitude to require feeding the total load from the South portal (including TBM) operations are no longer normal and normal load supply is not justified. The VE team feels that the above standby loads are more than adequate to feed necessary activities and support without a TBM. Lines and equipment should be sized accordingly, 5MVA.

**BEST APPLICATION OF ELECTRICAL DISTRIBUTION EQUIPMENT N. PORTAL
SWITCHGEAR VE-3
FUNCTIONS: SIZE COMPONENTS AND LOCATE COMPONENTS**

Although the VE study on Power Distribution to the North Portal from the Canyon Substation recommended that 25-16 substation not be changed, we recommend a change in configuration.

The apparent contradiction is just that, we are adding alternatives that were not included in that study.

The VE team recommends alternate 2 be adopted. Leave 25-16 15KV facility as is and eliminate building 5010 switchgear. Potential Savings: \$1,504,500, life-cycle costs.

**NORTH PORTAL DIESEL GENERATORS VE-4
FUNCTION: GENERATE POWER**

The VE team recommends that we lease three 1800KW units to satisfy standby needs. Leases should be exercised at six-month intervals. All lease costs apply to purchase of the unit. Based upon rough figures furnished by vendors, we would own the unit at approximately 15 months. The lease should be for six months with monthly extensions. That allows sufficient time for go or no go decisions based on actual conditions at the time to minimize costs in case of a major change for the YMP.

This option guarantees the greatest flexibility for financing, scheduling, and changing conditions, which buys time to assess actual conditions and other factors affecting decisions.

The lease concept is a win/win situation. We gain several months leeway in commitment times with no downside. Potential Savings: \$3,695,013 over refurbishing or \$829,140 over purchasing new units outright.

Having obtained a gift horse does not make it a bargain. If the horse comes in the shape of a white elephant, forget it. The four Kelly AFB generators proved to be the most expensive solution to Generate Power. The VE team recommends continual searching for gift horses and between perseverance and "horse trading" units needing minimum rehabilitation will be obtained. We recommend this course be pursued and that units be stockpiled or inserted into the power producing grid when they are found.

The VE team appreciates the opportunity to perform this study, applying the principles of independent thought and experience, to obtain these recommendations. The implementation of our recommendations are in the hands of decision-makers.

We believe the proposals are sound. They are made from technical and scientific viewpoints and scrutinized by two sieves for evaluation. They are not recommended lightly. We understand the political, budgetary, scheduling and other pressures bearing on decisions and volunteer our help and input to explain and defend what we propose, if needed. What we recommend will work. The alternatives are the lowest LCC solutions to each function. They will satisfy the function and furnish the same quality, reliability and essential qualities as any original concept, and will do it at the lowest LCC.

Please examine our worksheets. We have examined at least three workable solutions to each function. If, for some reason, our primary recommendations are not accepted, our second, third or even fourth alternative should be acceptable.

Daily Diaries YMP Power Distribution VE Study, August 15-18, 1994

Monday, August 15, 1994

Hank Spieker introduced himself and requested those present to do likewise. Hank distributed information packets Bill Kelly had prepared for both the VE process review and FAST diagrams to structure the project to be studied.

Jim Leak presented a summary of goals for the VE study, some history of the project evolution and what he was looking for from the VE team. Original thinking included two TBM's working from both the North and South portals. The portals were to be mirror facilities. Jim handed out current items that would make up the assumed configuration of the South portal. They are in the appendix.

The current plan has a 25' TBM for the main tunnel, an 18' TBM for cross-drifts and Calico Hills, and an 8' one for alcoves. There will be no drilling starting at the south portal. Jim wanted these three areas studied:

North portal current loads; how best served? General support facilities; GSFC complex, Surf. Based Testing, scheduling, amounts of loads. What is the best feed system? Route 12.47KV lines to all surface based testing. Would small generators at each location be best?

South portal. Original concept was to feed 12.47KV line from North portal. Is there a better feed approach? What about timing of installing it?

ESFDR requires standby generation. We have four 500KW high speed generators on hand. We have four 350KW slow speed generators on hand from Kelly AFB in Texas. O&M is higher on the high speed than the low speed. Should we refurbish the four slow speed or switch to larger units? Is it cheaper to rewind and install new controls on the four slow speed units or buy new?

Jim threw out several concerns, options and requests for alternatives.

The load list is the same as on the previous VE study. (Later, the VE team assumed the load study performed by the M&O contractor in July 1994 was valid for the function, Acquire Power, which is a function on our team's FAST diagram.) The 1A package is now being followed. Scenario A is very different now, it is getting tied into at present and becoming very specific in recommendations. Scenario A tunneling and licensing is fast tracked. Doesn't include main test area. Begins Calico Hills from North ramp. Allows testing to begin early. Hole out in 1997. File for licensing first and start testing after. Changes strategy. Impacts are farther out (WBSs).

We are locked into the four high speed units for standby power. Everything else is open for supplemental power. A limited feeder to the South portal is possible. The North portal supports TBMs/ventilation/lights/outlets, etc. The South portal has no TBMs, but has life support and operational support. Jim left as did other visitors.

Bill Kelly refreshed the VE team on VE basics and dove into the FAST diagrams he had prepared for the project. The team suggested revisions and selected functions for study. Bill