Design Analysis Cover Sheet

Complete only applicable items.

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Page: 1

Of: 8

QAC.
2-3-95

2. DESIGN ANALYSIS TITLE			
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9. Originator	ROBERT T. ROSCHE	<i>Robert T. Rosche</i>	2/3/95
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14. REMARKS			
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Design Analysis Revision Record

Complete only applicable items.

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Page: 2 Of: 8 2-345

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Title: IDCS Network and Storage Data Rate Analysis
Originator: R. T. Rosche

Page: 3 of 8
Date: 2/2/95

1. PURPOSE

The purpose of this design analysis is to establish estimated data rates for the Integrated Data and Control System (IDCS). These estimated data rates will be used to determine network traffic rates and data storage requirements for the initial IDCS installation as well as the longer term requirements. The data rates presented herein are largely based upon assumptions and therefore require close scrutiny from reviewers. It cannot be overemphasized that small changes in assumptions can lead to significantly different data rates from those presented herein.

2. QUALITY ASSURANCE

QA classification is "NONE". No QA controls are applicable.

3. METHOD

Reasonable assumptions, discussions with national laboratory principal investigators and representatives, direct calculations, and design input from LANL.

4. CODES AND STANDARDS

Not applicable.

5. DESIGN INPUTS

- 5.1 Site Characterization Test implementation plan. Overall Subsurface Layout TS Level Plan, Drawing BABEAD000-01717-2100-40100 Rev 01, 7/7/94
- 5.2 Projected Test Data Rates. YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT, INTEGRATED DATA AND CONTROL SYSTEM (IDCS), FUNCTIONAL REQUIREMENTS DOCUMENT (for Exploratory Studies Facility Testing Support), Revision 3.0, September 8, 1994. Los Alamos National Laboratory, Exploratory Studies Facility Test Coordination Office, Las Vegas, Nevada. Appendix C, Projected Test Data Rates.

6. CRITERIA

- 6.1 Hardware and software shall be provided as required by site characterization testing and construction to acquire data. [BFD, Rev 05, December 22, 1994, 7.4.1.IV.25]"

7. ASSUMPTIONS

- 7.1 Validity of current construction and testing schedules.

- 7.2 Calculation assumptions:

7.2.1 Facility Monitoring and Control System (FM&CS) data will be transmitted to the surface computer on "change" only during normal operating conditions (estimated to be 98% of the time). As a result, one 128 byte packet of data is expected from each point on an average of once per shift (8 hours). During abnormal operating conditions (estimated to be 2 % of the time), data will be transmitted to the host asynchronously at an estimated rate of one 128 byte data packet per point on an average of once per ten seconds. This assumption results in an average data rate of 2.1 bits/second/point for the FM&CS.

7.2.2 "Data rates for U. S. Geological Survey (USGS) radial borehole tests (RBT) and the Sandia National Laboratories (SNL) Construction Monitoring (CM) test were derived from participant documents. Data rates that were used for Thermal Tests are extrapolations from identified tests. The Thermal Tests are included to evaluate the effect of a large test on network rates and data storage capacity and not meant to accurately portray testing schedules or requirements. Aggressive testing schedules were assumed to accommodate possible changes in test planning. The values presented are base values. No factors or contingencies were applied to the calculated data rates. Deferred and short term tests were not included in this analysis. Short term tests are generally small and have little effect on test data rates. The remaining deferred tests will generate limited data, small compared to tests included in this analysis, and may be scheduled after a major data producing test such as CM has ended, further decreasing their impact on data rates." (See 5.2 above)

7.2.3 Activity during the first two years of tunnelling and testing activity in the Exploratory Studies Facility (ESF) is assumed to be representative of activity over the life of the project; i.e., average data rates for the first two years of activity can be extrapolated over the life of the project on a linear

Title: IDCS Network and Storage Data Rate Analysis
Originator: R. T. Rosche

Page: 5 of 8
Date: 2/2/95

basis.

- 7.2.4 Approximately 18,000 total data points will be in service at some point during the life of the project. A maximum of 80% of such data points will be in service at any given point in time.
- 7.2.6 An "average" data packet will be comprised of 128 bytes.
- 7.2.7 The figures presented in the analysis below represent data collected by sensors and instruments only. Network overhead, alarms, events, and other data streams normally associated with the tunnelling and testing activity are not included in these numbers. Rather, these other data streams are represented by a 100% overhead factor applied to the raw data rates.
- 7.2.8 A contingency factor of 50% is added to the raw data rates plus overhead to account for variations in data rates among tests not currently defined or scheduled, and to account for the thermal tests, currently scheduled for fourth quarter, FY97, which could consist of as many as 10,000 channels with an average data rate of 71.1 bits per second.

8. REFERENCES

- 8.1 USGS, informal meetings with Falah Thamir.
- 8.2 SNL, informal discussions with Scott Carlisle (Agapito & Associates).

9. COMPUTER PROGRAMS

Not Applicable.

10. DESIGN ANALYSIS

- 10.1 Assumed time line of events, on-line IDCS elements, and data rates for the first two years of tunnelling and testing activity:

Title: IDCS Network and Storage Data Rate Analysis
 Originator: R. T. Rosche

Page: 6 of 8
 Date: 2/2/95

DATE	EVENT	ON-LINE ELEMENTS	No. of Data Points	Data Rate (Bits / sec.)	Cumulative Number of Data Points	Cumulative Data Rate (Bits/Sec.)
8/94	TBM Start-up	FM&CS (7.2.1)	400	840	400	840
9/94					400	840.
10/94					400	840
11/94	TBM Running	FM&CS	200	420	600	1260
		USGS RBT #1 (7.2.2)	140	2.1	740	1262.1
		SNL CMS #1 (7.2.2)	200	1.5	940	1263.6
12/94	TBM Running	FM&CS	200	420	1140	1683.6
		SNL CMS #2	200	1.5	1340	1685.1
1/95						
2/95	TBM Running	FM&CS	200	420	1540	2105.1
		SNL CMS #3	200	1.5	1740	2106.6
3/95						
4/95						
5/95	TBM Running	FM&CS	200	420	1940	2526.6
		SNL CMS #4	200	1.5	2140	2528.1
6/95						
7/95						
8/95	TBM Running	FM&CS	200	420	2340	2948.1
		SNL CMS #5	200	1.5	2540	2949.6
9/95						
10/95	TBM Running	FM&CS	200	420	2740	3369.6
		SNL CMS #6	200	1.5	2940	3371.1
11/95						

DATE	EVENT	ON-LINE ELEMENTS	No. of Data Points	Data Rate (Bits / sec.)	Cumulative Number of Data Points	Cumulative Data Rate (Bits/Sec.)
12/95	TBM Running	FM&CS SNL CMS #7	200 200	420 1.5	3140 3340	3791.1 3792.6
1/96	TBM Running	SNL CMS #8	200	1.5	3540	3794.1
2/96	TBM Running	FM&CS	200	420	3740	4214.1
3/96	TBM Running	SNL CMS #9	200	1.5	3940	4215.6
4/96	TBM Running	FM&CS	200	420	4140	4635.6
5/96	TBM Running	SNL CMS #10	200	1.5	4340	4637.1
6/96	TBM Running	FM&CS	200	420	4540	5057.1
7/96	Hole Out South Portal	SNL CMS #11	200	1.5	4740	5058.6
IDCS 1st 2 years					4740	5058.6

10.2 Average Peak data rate (bits/second/point), first two years of activity =
 $5058.6/4740 = 1.0672$ bits/second/point. 1.0672 bits/second/point = $(1.0672 * 4740 * 86400 \text{ seconds/day})/8 \text{ bits/byte} = 54,632,879 \text{ bytes/day}$.

10.3 Extrapolated average peak data rate (bits/second/point), overall project life =
 1.0672 bits/second/point. 1.0672 bits/second/point = $(1.0672 * (18000 * .8) * 86400 \text{ seconds/day})/8 \text{ bits/byte} = 165,973,306 \text{ bytes/day}$.

Title: IDCS Network and Storage Data Rate Analysis

Page: 8 of 8

Originator: R. T. Rosche

Date: 2/2/95

- 10.4 Peak data rate with overhead, first two years = $54,632,879 \text{ bytes/day} * 2 = 109,265,758 \text{ bytes/day}$.
- 10.5 Peak data rate with overhead, overall project life = $165,973,306 \text{ bytes/day} * 2 = 331,946,612 \text{ bytes/day}$.
- 10.6 Peak data rate with overhead and contingency, first two years = $109,265,758 \text{ bytes/day} * 1.5 = 163,898,637 \text{ bytes/day}$.
- 10.7 Peak data rate with overhead and contingency, overall project life = $331,946,612 \text{ bytes/day} * 1.5 = 497,919,918 \text{ bytes/day}$.

11. CONCLUSIONS

- 11.1 Network traffic and data storage requirements for the first two years of tunnelling and testing activity at the ESF should be based on a peak data rate with overhead and contingency of approximately 165 MegaBytes (MB) per day.
- 11.2 Network traffic and data storage requirements for the overall project life should be based on a peak data rate with overhead and contingency of approximately 500 MB per day.

12. ATTACHMENTS

Not Applicable.