ATTACHMENT 1

13-NC-QD-200, REVISION 2

REVISION 02

Palo Verde Nuclear Generating Station

CALCULATION REVISION/TITLE SHEET

CALCULATION NO.	REV.	CLASS:	AFFECTED SHEET NO(S)
13-NC-QB-200	2	Q ☐ QAG ☐ NQR ☒	See below

CALCULATION TITLE	ISSUED
Calculation for Holophane Emergency Lighting Unit Availability Study	1/30/92

AFFECTED CHANGES	REFERENCE(S)	UNITS AFFECTED
N/A	NRC Inspection Report #IR528/91-30-00 Letter#102-02091-WFC/TRB/DLK, 12/27/91	☒ UNIT 1 ☒ UNIT 2 ☒ UNIT 3 ☐ COMMON

REASON FOR CHANGE

Partition: RCTS **CATS No.:** 040847 "Evaluate commitment in letter 102-02091-WFC/TRB/DLK, Attachment 1, Section I.b., Par 7 and provide compliance with CATS action sheets that implement the commitment." **Action 01:** "In letter 102-02091, APS committed to provide updated information to the NRC on Exide and Holophane inverter availability by 01/31/92."

DESCRIPTION OF CHANGE

Description

This revision (2) incorporates updated availability data obtained for the time period of June 1990 through November 1991. This information was prepared in a manner consistent with that specified within the body of the original calculation.

Pages Changed

Table of Contents, page 1 of 14
6.0 References, page 5 of 14

Pages Added

Table 3: Input Data and Calculated Known and Estimated Unavailable Days(1991), Pages 21 - 23
Table 4: Calculation of Unit and Plant Availabilities(1991), Page 24 - 25
Table 5: Availability Comparison (1990 - 1991), Page 26 - 27
Appendix B: Work Order History Graphs (1991), Pages 28 - 40

Preparer	Dwg. Check	Mech.	Civil	Elec.	I & C	Technical Review	Other (Specify Org.)	Other (Specify Org.)	RS	NEM
J.R.Wadella Tech. Issues	N/A	N/A	N/A	N/A	N/A	S.K. Guy PRA	C.A. Cooper F.P. Engr.	N/A	D.C. Fan PRA	N/A
01/06/92						1/8/92	1-16-92		1/16/92	
Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date

CROSS DISCIPLINE REVIEW

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1.0 PURPOSE

This calculation is performed as part of the PVNGS response to NRC Inspection Report 90 -121. Pages five and six of that report provide failure data on Holophane, Exide and Emergi-Lite units. The data is presented on a reliability basis, e.g., 4 of 4 Holophane units (100%) failed in Unit 1 in 1988. The conclusion is drawn that the emergency lighting is not reliable.

While the failure numbers used by the NRC in the report are an accurate reproduction of data provided to the NRC in the June 29, 1990 letter, their method of portraying failures can be misleading. The purpose of this study is to provide a more proper way of portraying the failures of the Holophane units.

2.0 SUMMARY

An average unavailability indicator was developed. The unavailability indicator for each component (and group of components) is calculated for a specific time period by dividing the total number of unavailable days by the total number of days in the time period. Thus, a value of zero means a component was always available. A value of one implies a component was never available. This method is basically the method employed by INPO (Ref. 1) to monitor the readiness of important safety systems to respond to off-normal events or accidents. An availability indicator is obtained by subtracting the unavailability from one.

The resulting average availability indicators for the various units and Holophanes as a whole, based on a time period from June 29, 1989 to June 30, 1990 are as follows:

Unit 1: 0.99

R1 Unit 2: 0.95

Unit 3: 0.87

R1 Unit Average: 0.94

3.0 CRITERIA AND ASSUMPTIONS

There are no applicable design criteria, design assumptions, codes, standards, or other requirements for this calculation. The basic equation used to calculate the average estimated unavailability for a Holophane unit is to divide the total number of unavailable days by the total number of days in the selected time period.

The details involved are described in Section 5.

Two assumptions are made in this calculation. The first assumptions deals with estimating the calendar date when the Holophane failed. Following an accepted reliability approach the failure is assumed to have occurred mid-point between the last date the component is known to have been operational and the component failure discovery date. The second assumption is that is for each Holophane unit there are no failures in the time period from the last Holophane unit test to 6/30/90. This is the assumption as made for INPO's safety system unavailability monitoring, i.e. if the failure is not observed then it assumed that there has not been a failure.

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4.0 INPUT DATA

The input data for this calculation is a series of failure data for each Holophane unit that identify the failure discovery date, the component repair date, and the last date that component is know to have been operational. This information is used to calculate a known unavailable time and an estimated unavailable time as described in Section 5.1. The failure data is based on a review of Holophane work orders performed by an EED Electrical task force related to Emergency Lighting. A series of graphs were prepared which depict the work order history of the Holophane units for the time frame June 29, 1989 to June 30, 1990. These graphs serve as a visual aid and help document which work orders contain information relating to failure data. They are provided as Appendix A.

R1

The failures were compared with Holophane failure evaluations previously described to the NRC in Reference 2.The results of that comparison follow.

- Unit 1: QBN-001 - consistent with Reference 2.
- Unit 1: QBN-002 - consistent with Reference 2 -the failure date here is one day earlier than in Reference 2 since the that is the day the new batteries were installed.
- Unit 1: QBN-003 - consistent with Reference 2.
- Unit 1: QBN-004 - consistent with Reference 2.
- Unit 2: QBN-001 - consistent with Reference 2.
- Unit 2: QBN-002 - consistent with Reference 2 with the following exception. An 8 hour discharge test was supposed to have occurred prior to Unit 2 restart on 6/29/89, but did not occur until 7/3/90. This is treated as 4 days of unavailability.
- Unit 2: QBN-003 - the failure on 05/11/90 described in Reference 2 has since been reclassified as no failure.
- Unit 2: QBN-004 - the failures on 12/29/89 and 5/11/90 described in Reference 2 have since been reclassified as no failures.
- Unit 3: QBN-001 - consistent with Reference 2 with the clarification that the 3-11-90 event is not a failure.
- Unit 3: QBN-002 - consistent with previous evaluations.
- Unit 3: QBN-003 - consistent with Reference 2.
- Unit 3: QBN-004 - consistent with Reference 2.

The failure data is contained in Table 1.

5.0 CALCULATION AND RESULTS

5.1 Method

An unavailability indicator was developed to quantify the readiness of Holophane units to respond to situations in which they would be required. The indicator for each component (or any group of components) is calculated for a specific time period by dividing the total number of unavailable days by the total number of days in the time period. Thus, a value of zero for a component means the component was always available. A value of one

means a component was never available. This method is basically the method employed by INPO to monitor the readiness of important safety systems to respond to off-normal events or accidents.

The method requires the development of known and estimated unavailable time periods. The known unavailable time periods are the times a component is not available for service when the beginning and ending time of the unavailability due to a failure are known, i.e. failure discovery time and repair time respectively. The estimated time periods are the average times a component was in a failed state prior to failure discovery. This time is estimated as one-half time interval measured from the last time the component is know to be operable to the time it is discovered as failed. Thus, for a component which failed an eight-hour discharge test, the estimated unavailable time would probably be one-half the time since the last successful eight-hour discharge test for that component. A more recent preventive maintenance would be used if a determination could be made that the specific failure mode would have been detected by the maintenance. The unavailable times described above are only those stemming from events judged to be component failures.

5.2 Scope

The scope of this evaluation includes all Holophane Units in Units 1, 2, and 3. The time period begins on June 29, 1989 (Unit 2 restart). The process of determining failure dates, repair dates, and last known available dates requires extensive review of work orders. These work orders are not intended for this purpose and chronological reconstructions can be difficult and time consuming. The selection of 6/29/89 as a start date for this calculation is based on it being both representative and recent. An end date of 6/30/90 was chosen as the conclusion of the time period for this study. The basis for the selection of this end date is that it allows for an extended history without having to consider open work orders. Although the limited time period is based on time and resource constraints, a one-year period is considered adequate to estimate Holophane availability.

5.3 Calculation Process

The calculation process used is straight-forward. For each failure event, three dates are required as input data: the failure discovery date, the component repair date, and the last date the component is known to have been available. The time between the failure discovery date and the component repair date is the known unavailable hours as discussed in Section 5.1. The estimated unavailable time is one-half the time between the last time the component is known to be available and the failure discovery date. An exception to this calculation of the estimated unavailable time is made for cases in which the estimated unavailable time period is prior to the June 29, 1989 start date. In those cases, the estimated unavailable time is taken from the start date to the failure date. The calculated known and estimated unavailable days are shown with the input data in Table 1. Once the known and estimated unavailable days are determined for each component, they are entered into a spreadsheet which: (1) totals the known and estimated unavailable days for each component; and, (2) calculates the component average unavailability indicator by dividing this total by the total time period for the component (366 days). The spreadsheet also sums the unavailable days and the total time periods for all the components in a unit, and then calculates a unit average. This process is repeated for all three units. A Holophane overall plant unit average is calculated. The spreadsheet calculations were manually verified. The spreadsheet is duplicated in Table 2.

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5.4 Results

The resulting average availability indicators for the various units and Holophanes as a whole, based on a time period from June 29, 1989 to June 30, 1990 are as follows:

Unit 1: 0.99
Unit 2: 0.95
Unit 3: 0.87
Unit Average: 0.94

6.0 REFERENCES

1. August 30, 1989 Letter from Terence J. Sullivan of INPO to William F. Conway Enclosure 2

2. August 1, 1990 letter from W. F. Conway to J. B. Martin: 161-03373-WFC/WFQ

3. December 27, 1991 letter from W. F. Conway to J. B. Martin: 102-02091-WFC/TRB/DLK

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TABLE 1. Input Data and Calculated Known and Estimated Unavailable Days

Equipment ID	Discovery Date	Repair Date	Last Known Available Date	Unavailable Known Days	Unavailable Estimated Days	Unavailable Total Days
1EQBNN01	No Failures					
1EQBNN02	08-May-90	26-May-90	08-May-90	18	0	18
1EQBNN03	No Failures					
1EQBNN04	No Failures					
2EQBNN01	05-Mar-90	16-Mar-90	22-Nov-89	11	51.5	62.5
2EQBNN02	29-Jun-89	03-Jul-89	29-Jun-89	4	0	4
2EQBNN03	No Failures					
2EQBNN04	No Failures					
3EQBNN01	*29-Jun-89	25-Jul-89	29-Jun-89	26	0	26
3EQBNN02	No Failures					
3EQBNN03	03-May-90	18-Jun-90	05-Oct-89	46	105	151
3EQBNN04	07-Feb-90	16-Feb-90	07-Feb-90	9	0	9

* The actual discovery date was June 8. The June 29 date is the start time for the availability evaluation.

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TABLE 2. Calculation of Unit and Plant Availabilities

Equipment ID	Known Unavailable Days	Estimated Unavailable Days	Total Unavailable Days	Required Days	Average Availability
1EQB..01	0	0	0	366	100.0%
1EQB..02	18	0	18	366	95.1%
1EQB..03	0	0	0	366	100.0%
1EQB..04	0	0	0	366	100.0%
Totals	18	0	18	1464	
			Average Unit Availability		98.8%
2EQB..01	11	51.5	62.5	366	82.9%
2EQB..02	4	0	4	366	98.9%
2EQB..03	0	0	0	366	100.0%
2EQB..04	0	0	0	366	100.0%
Totals	15	51.5	66.5	1464	
			Average Unit Availability		95.5%
3EQB..01	26	0	26	366	92.9%
3EQB..02	0	0	0	366	100.0%
3EQB..03	46	105	151	366	58.7%
3EQB..04	9	0	9	366	97.5%
Totals	81	105	186	1464	
			Average Unit Availability		87.3%
Plant Totals	114	156.5	270.5	4392	
			Average Plant Availability		93.8%

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APPENDIX A

WORK ORDER HISTORY GRAPHS

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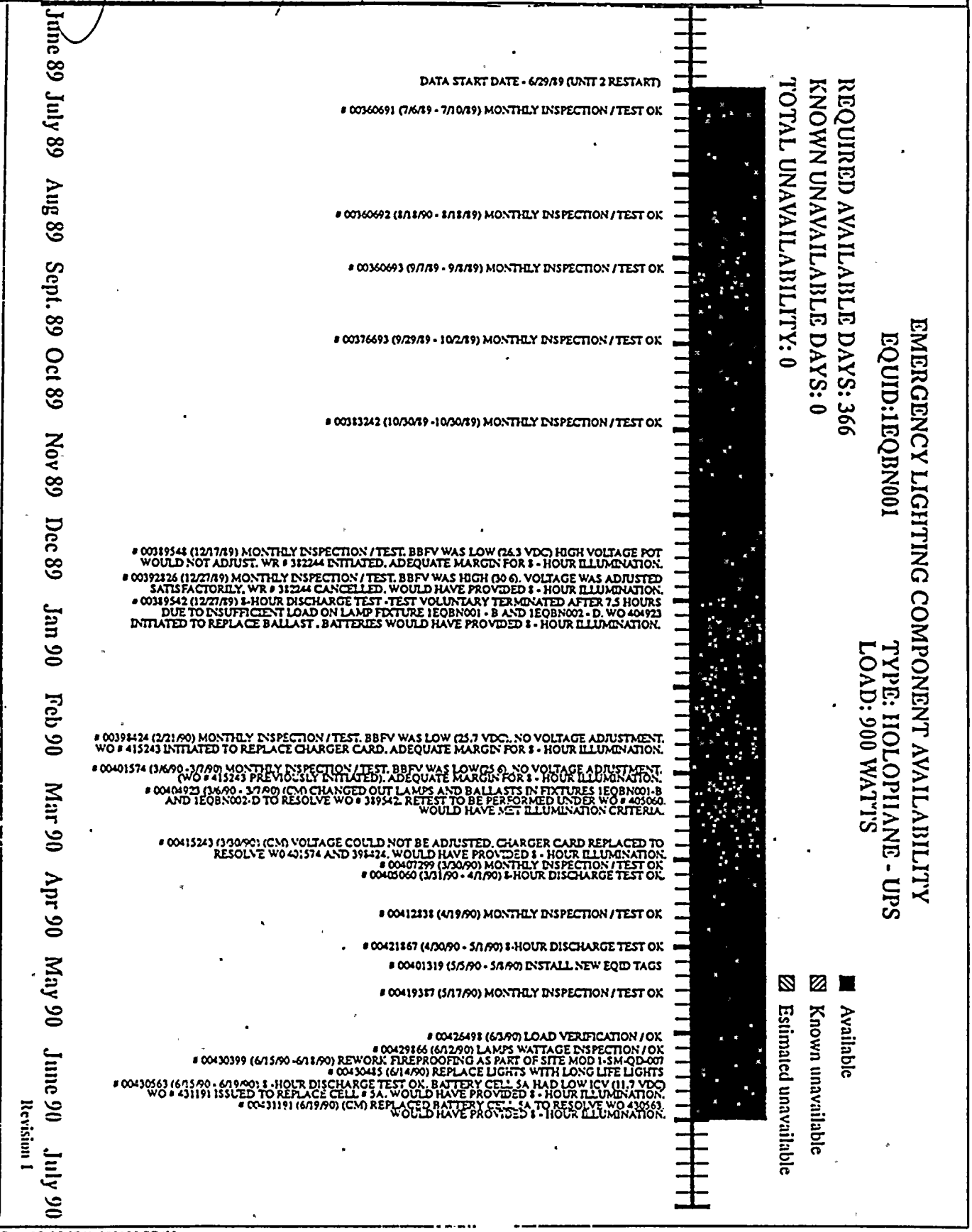

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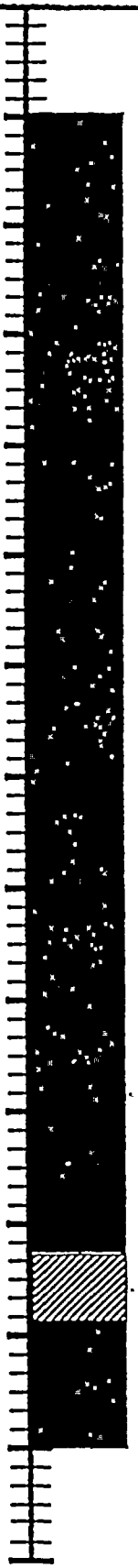
EMERGENCY LIGHTING COMPONENT AVAILABILITY
EQUID:1EQBN002
TYPE: HOLOPHANE - UPS
LOAD: 700 WATTS

REQUIRED AVAILABLE DAYS: 366
KNOWN UNAVAILABLE DAYS: 18
ESTIMATED UNAVAILABLE DAYS: 0

■ Available
▨ Known unavailable
▨ Estimated unavailable



DATA START DATE - 6/29/89 (UNIT 2 RESTART)

00360695 (7/6/89 - 7/10/89) MONTHLY INSPECTION / TEST OK

00360696 (8/18/89 - 8/18/89) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.1 VDC) WO # 348770 INTIATED TO REPLACE CELL # 1A. WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00360697(9/7/89 - 9/9/89) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.19 VDC) (WO # 348770 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00376694 (9/29/89 - 10/2/89) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.2 VDC) (WO # 348770 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00383243 (10/30/89 - 10/30/89) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.2 VDC) (WO # 348770 PREVIOUSLY INTIATED). CELL # 3A HAD A CRACKED / FLATTENED BATTERY POST. WO# 419231 INITIATED TO REPLACE CELL # 3A. WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00389549 (12/17/89 - 12/17/89) MONTHLY INSPECTION / TEST - BATTERY # 1A HAD LOW IBV (11.1 VDC) (WO # 348770 PREVIOUSLY INTIATED). CELL # 3A HAD A CRACKED / FLATTENED BATTERY POST. (WO# 419231 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00392827 (12/27/89 - 12/27/89) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.2 VDC) (WO # 348770 PREVIOUSLY INTIATED). CELL # 3A HAD A CRACKED / FLATTENED BATTERY POST. (WO# 419231 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00389543 (12/27/89 - 1/6/90) 8-HOUR DISCHARGE TEST -TEST VOLUNTARY TERMINATED AFTER 7.5 HOURS DUE TO INSUFFICIENT LOAD. FAULTY BALLAST ON LAMP FIXTURE 1EQBN002-D WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION. WO 404923 INTIATED TO REPLACE BALLAST.

00398425(2/21/90 - 2/21/90) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.2 VDC) (WO # 348770 PREVIOUSLY INTIATED). CELL # 3A HAD A CRACKED / FLATTENED BATTERY POST. (WO# 419231 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00401575 (3/6/90 - 3/7/90) MONTHLY INSPECTION / TEST - BATTERY CELL # 1A HAD LOW IBV (11.2 VDC) (WO # 348770 PREVIOUSLY INTIATED). CELL # 3A HAD A CRACKED / FLATTENED BATTERY POST. (WO# 419231 PREVIOUSLY INTIATED). WOULD HAVE PROVIDED 8 - HOUR ILLUMINATION.

00404923 (3/6/90 - 3/7/90) (CM) DIM LIGHTS, CHANGED OUT LAMPS AND BALLASTS IN FIXTURES 1EQBN001-B AND 1EQBN002-D WOULD HAVE MET ILLUMINATION CRITERIA REF. WO # 389543 AND 405061

00348770 (3/24/90 - 3/26/90) (CM) REPLACE CELL # 1A AND 3A (REF WO # 419231)

00405061 (3/26/90 - 3/30/90) 8 - HOUR DISCHARGE TEST OK

00407300 (3/27/90 - 4/2/90) MONTHLY INSPECTION / TEST OK

00412839 (4/19/90 - 4/19/90) MONTHLY INSPECTION / TEST OK

00419231 (5/1/90 - 5/14/90) (CM) REPLACED BATTERIES PER MNCR 90-QB-003 WO # 00424862 ISSUED FOR RETEST

00424862 (5/9/90 - 5/11/90) 8-HOUR DISCHARGE TEST FAILED(7.5 HOURS). DEFECTIVE BATTERIES INSTALLED UNDER WO # 419231. WO # 425827 INITIATED TO INSTALL NEW BATTERIES. WOULD HAVE PREVIOUSLY PASSED 8 - HOUR TEST

00419388 5/17/90 - 5/26/90 MONTHLY INSPECTION / TEST OK

00425827 (5/20/90 - 6/5/90) (CM) BATTERIES REPLACED TO RESOLVE FAILURE FROM WO # 00424862

00425962 (5/21/90 - 5/26/90) 8 - HOUR DISCHARGE TEST OK. RESTORED FAILURE FROM WO # 00424862

00426500 (6/4/90 - 6/12/90) (CM) CHECKED INVERTER LOAD AND FUSES / OK

00429805 (6/12/90 - 6/12/90) (CM) CHECKED 40W LAMPS / OK

00428019 (6/19/90 -6/19/90) MONTHLY INSPECTION / TEST OK

00429189 (7/9/90 - 7/10/90) MONTHLY INSPECTION / TEST OK

June 89 July 89 Aug 89 Sept. 89 Oct 89 Nov 89 Dec 89 Jan 90 Feb 90 Mar 90 Apr 90 May 90 June 90 July 90

Revision 1

ENGINEERING SKETCH PAD

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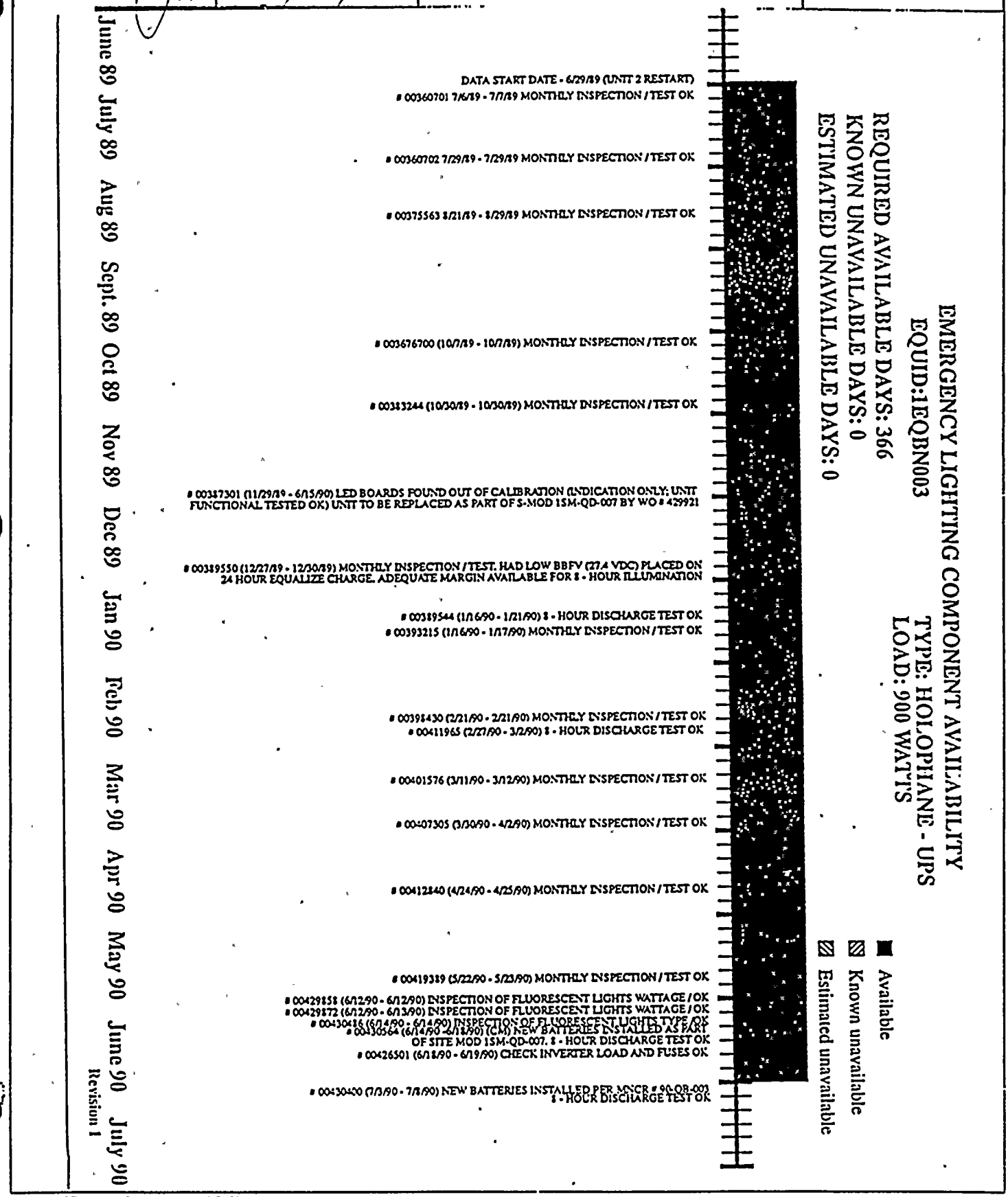

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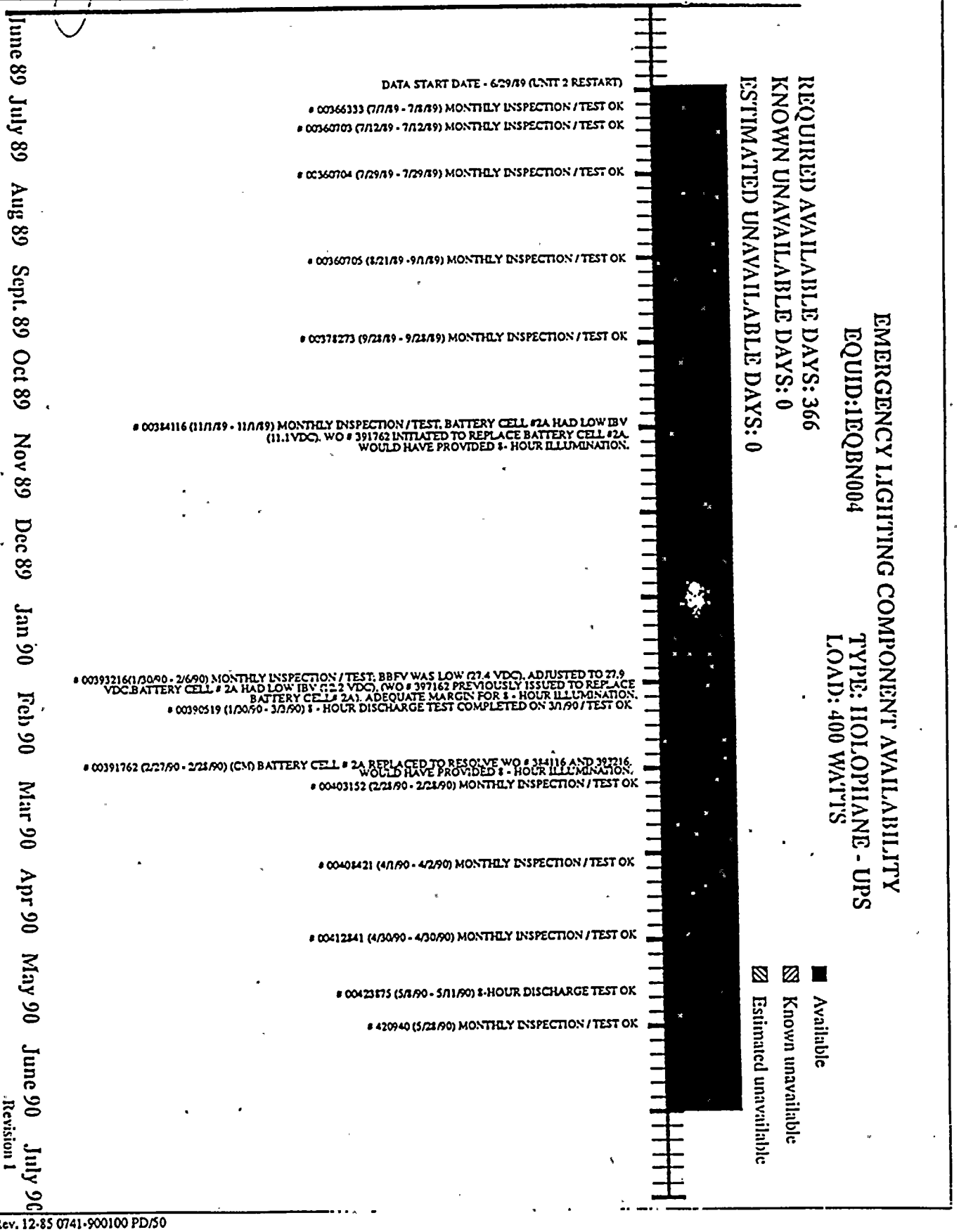

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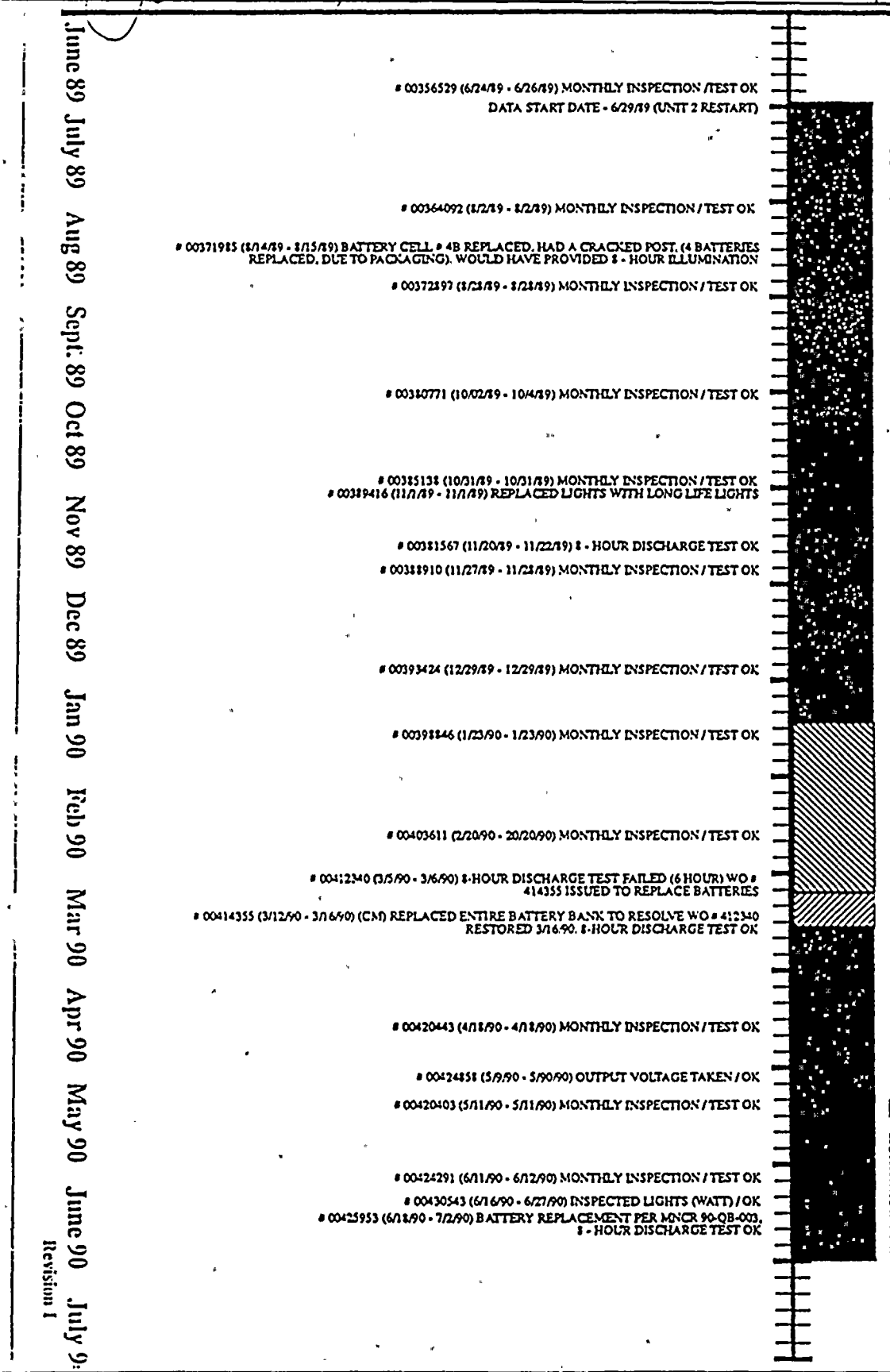

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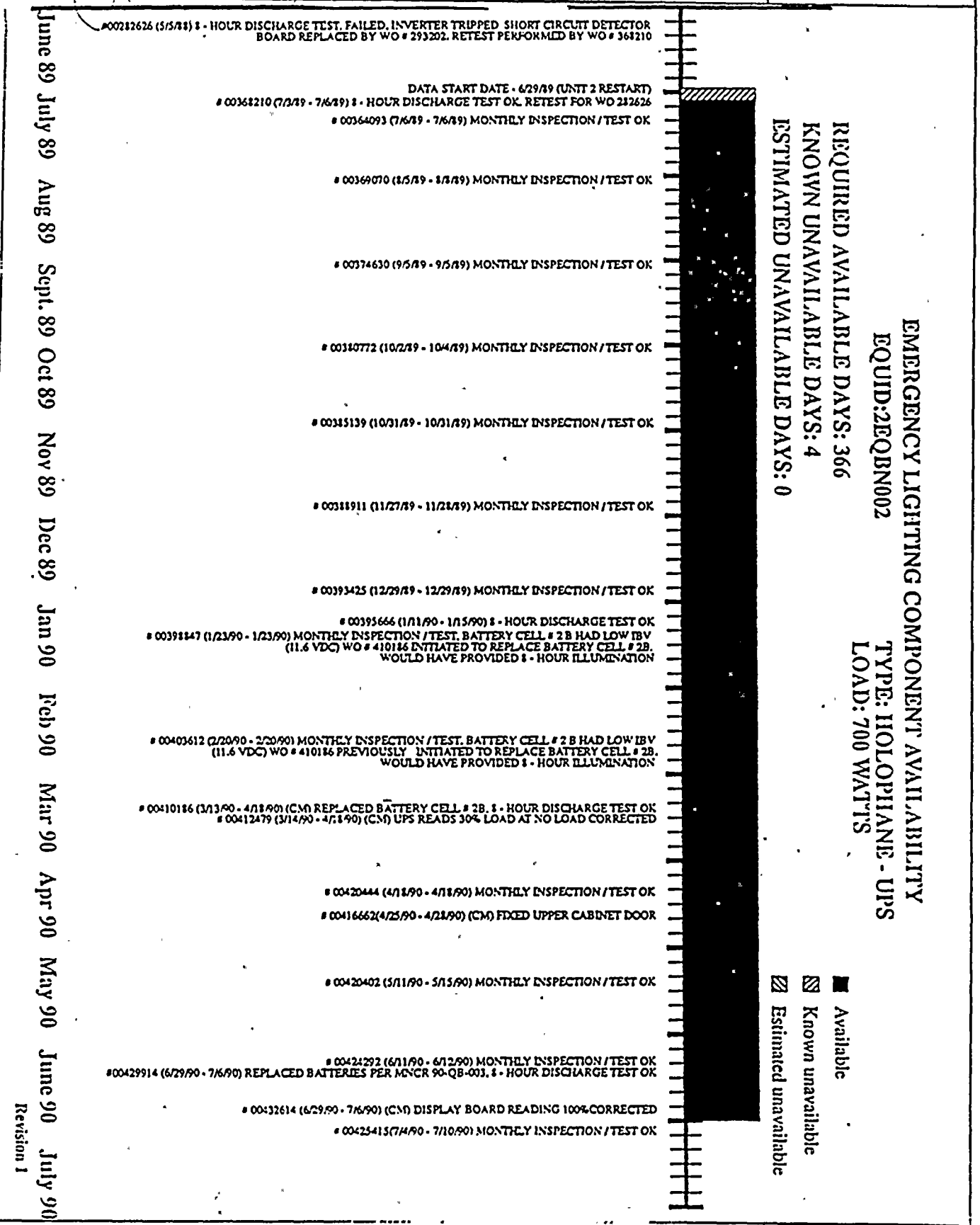

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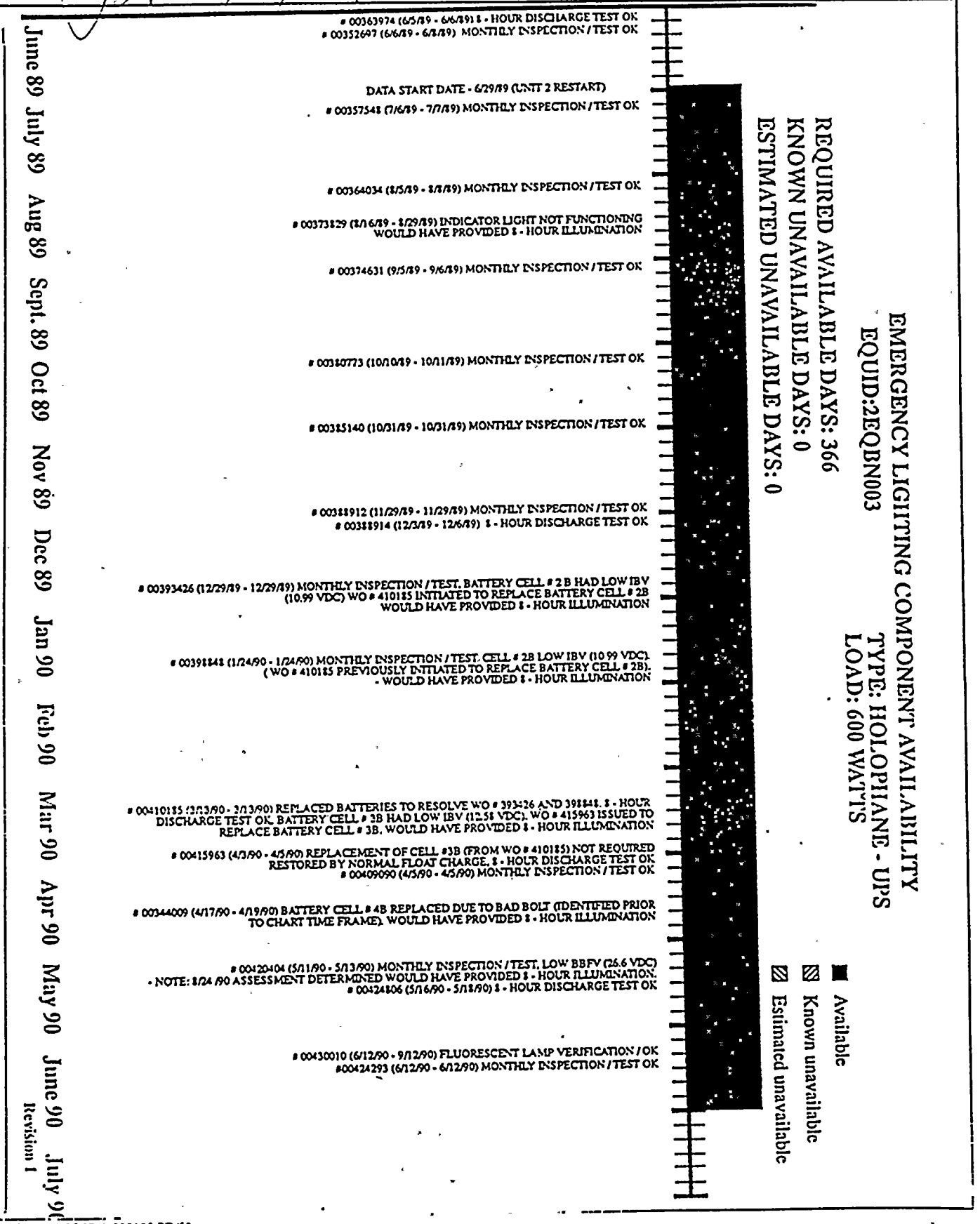

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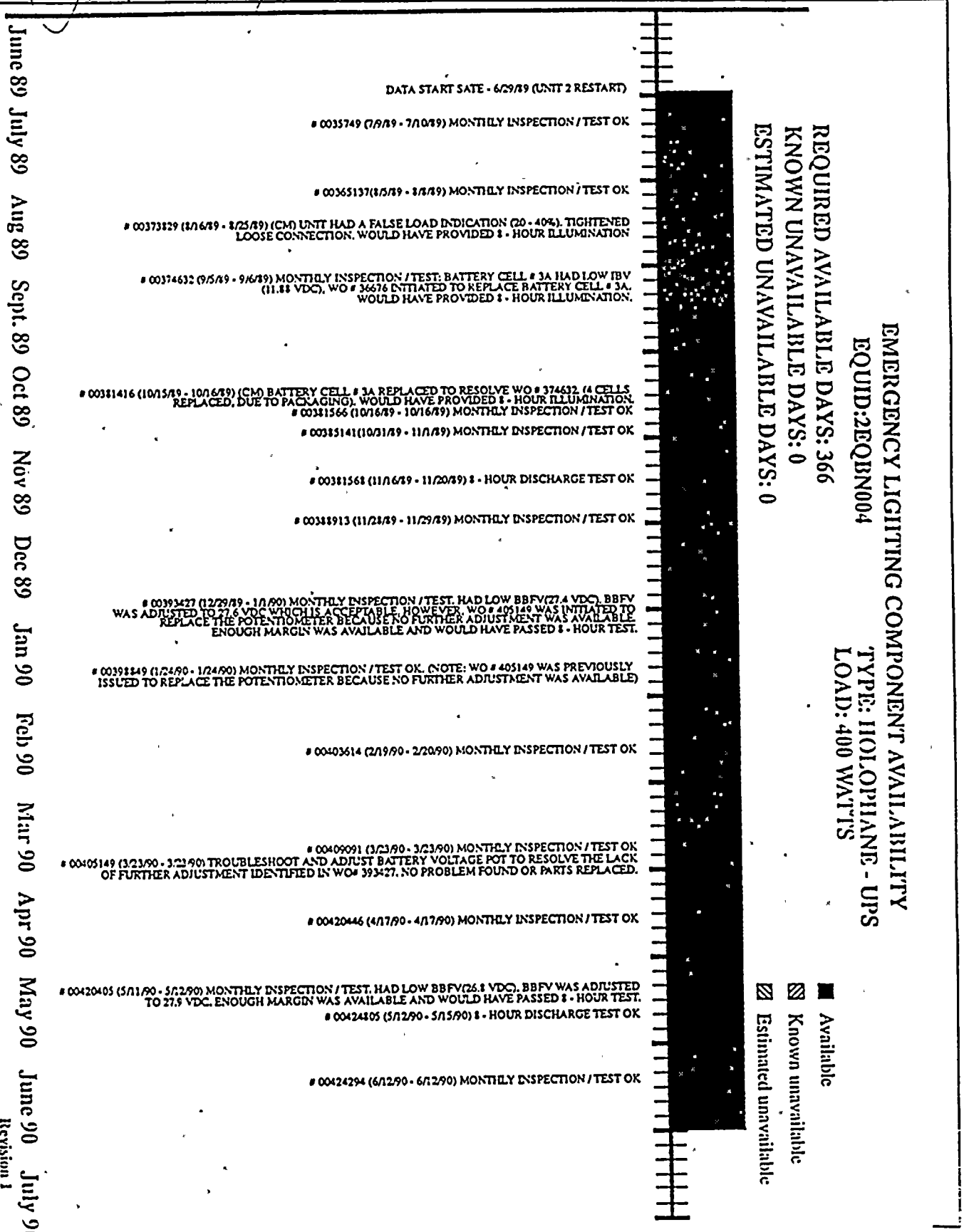

ENGINEERING SKETCH PAD

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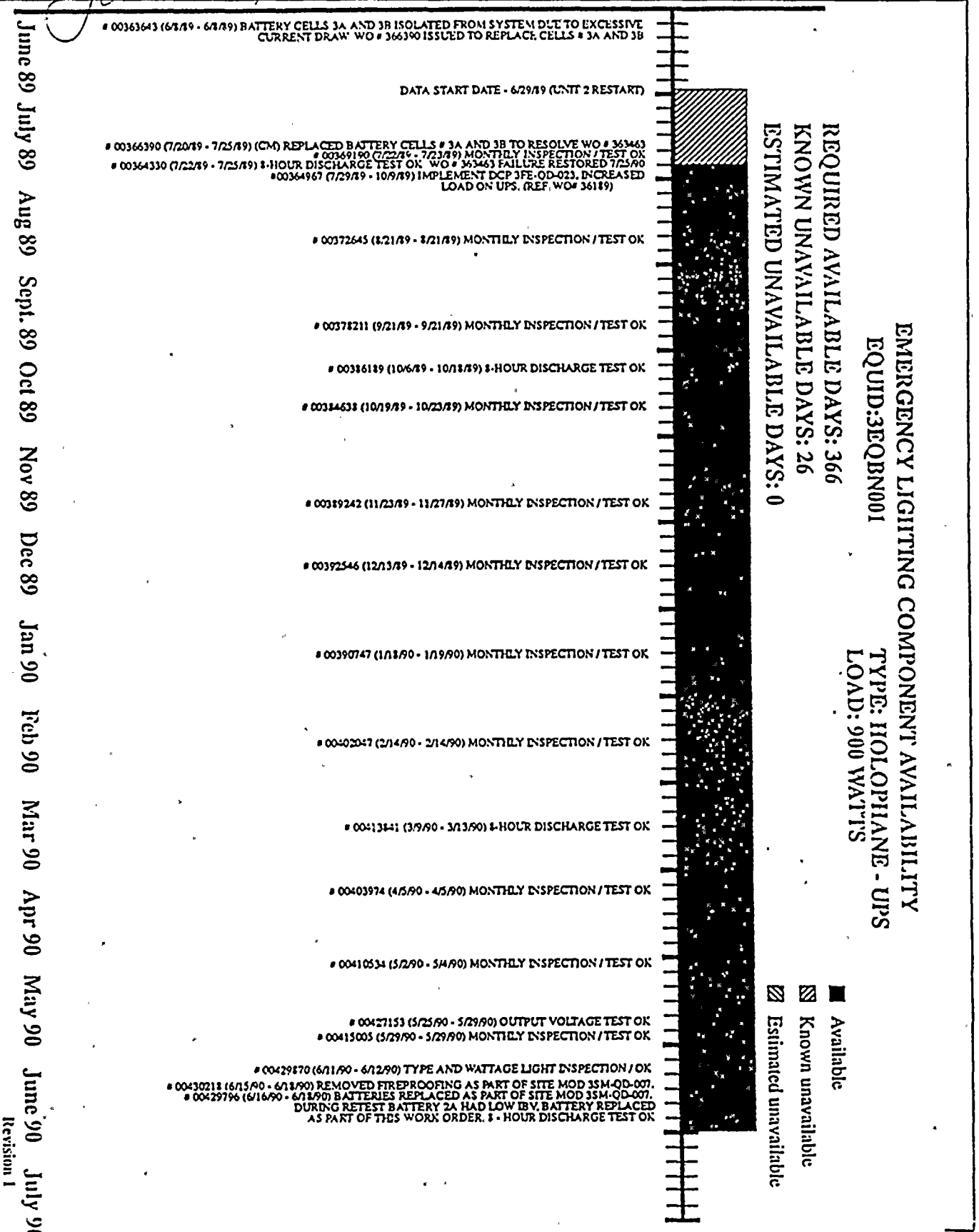

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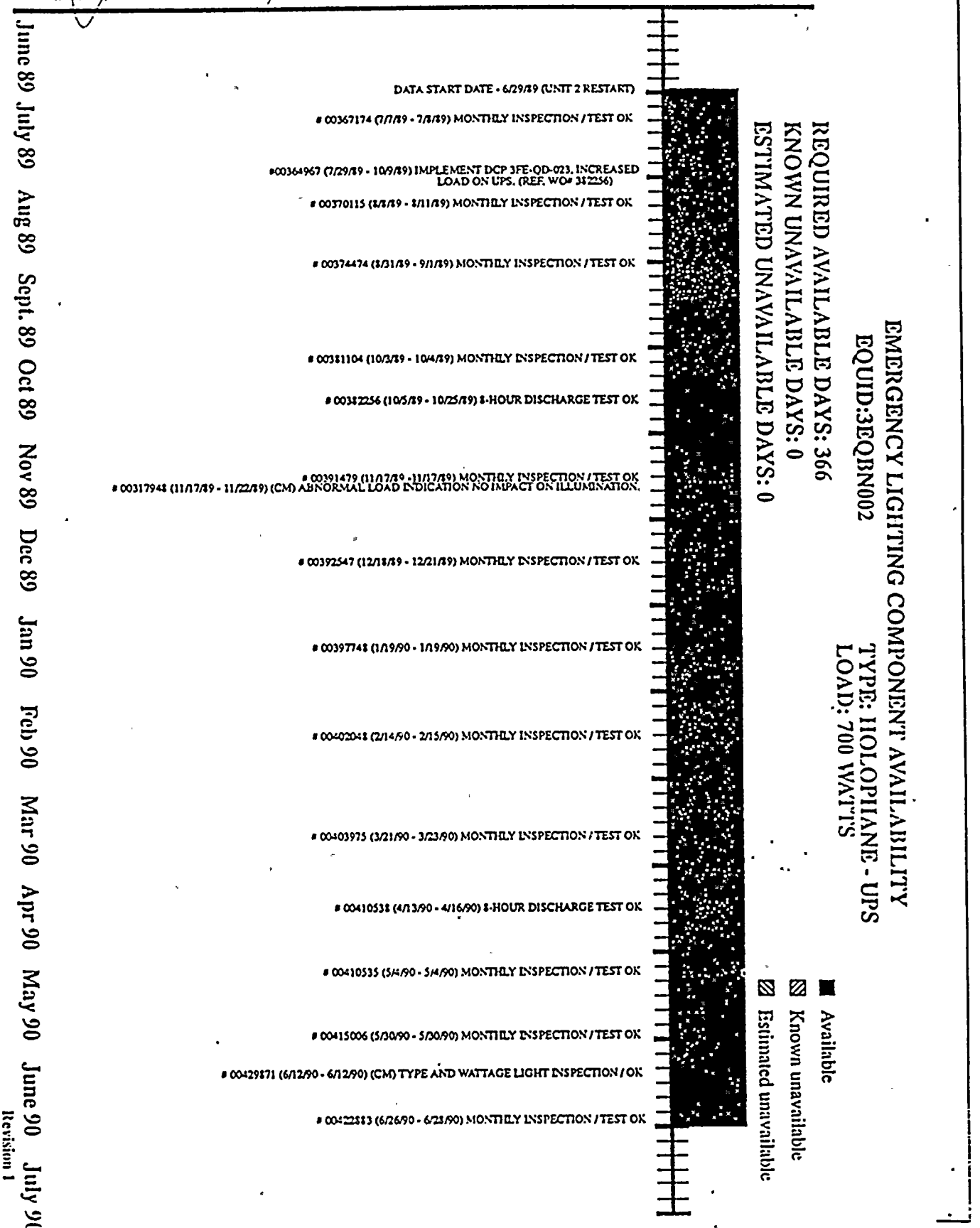

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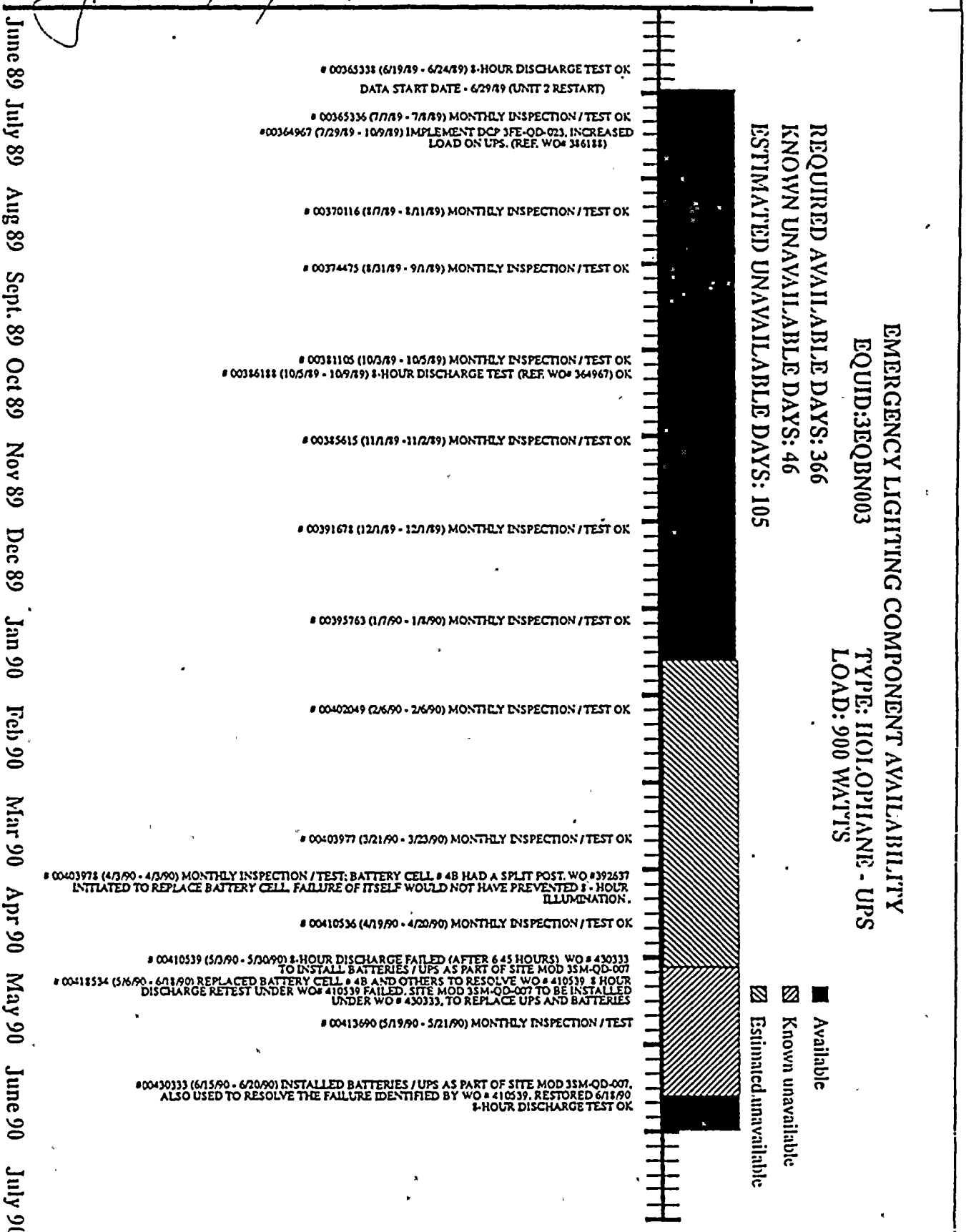

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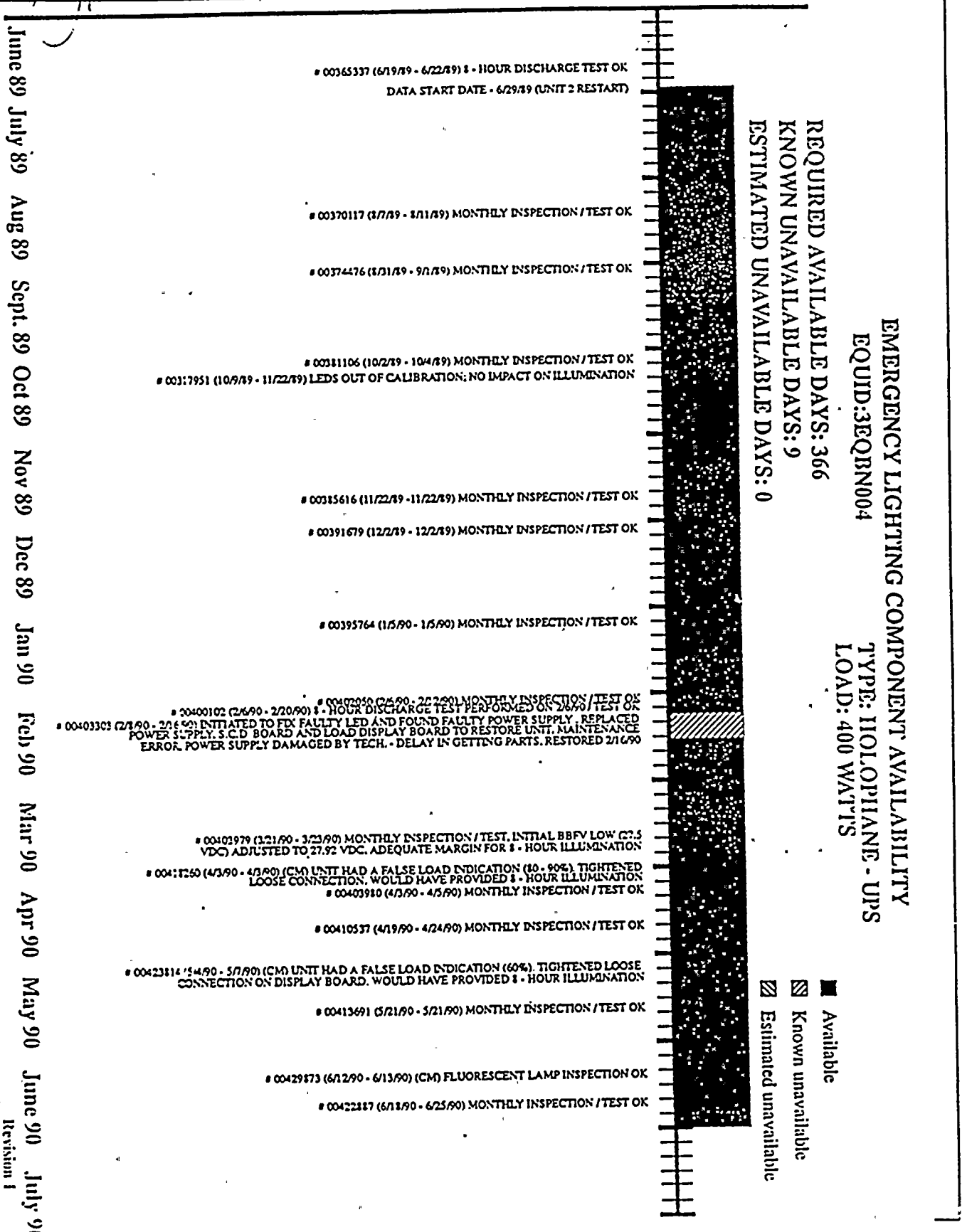
EMERGENCY LIGHTING COMPONENT AVAILABILITY
EQUID:3EQBN004
TYPE: HOLOPHANE - UPS
LOAD: 400 WATTS

REQUIRED AVAILABLE DAYS: 366
KNOWN UNAVAILABLE DAYS: 9
ESTIMATED UNAVAILABLE DAYS: 0



Revision 1

BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page 21
CHECKED BY: Sandra K. Guy SKG	DATE: 08 Jan 92		JOB NO.: 13-NC-QB-200

TABLE - 3

INPUT DATA AND CALCULATED KNOWN AND ESTIMATED UNAVAILABLE DAYS (1991)

BY	DATE	SUBJECT	SHEET NO.
John R. Wadella	06 Jan 92	CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	Page 22
CHECKED BY. Sandra K. Guy	DATE: 08 Jan 92		JOB NO.: 13-NC-QB-200

TABLE 3. Input Data and Calculated Known and Estimated Unavailable Days

Equipment ID	Discovery Date	Repair Date	Last Known Available Date	Unavailable Known Days	Unavailable Estimated Days	Unavailable Total Days
UNIT-1						
1EQBN001	*12-June-90	18-June-90	12-June-90	6	0	6
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
1EQBN002	*01-Aug-90	12-Aug-90	01-Aug-90	11	0	11
	#09-Nov-90	16-Nov-90	09-Nov-90	7	0	7
* Unavailability due to the implementation of Site Modification #SM-QD-007						
# Unavailability due to battery replacement / retest (Re: WO #00448138)						
1EQBN003	*12-June-90	17-June-90	12-June-90	5	0	5
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
1EQBN004	*02-Aug-90	14-Aug-90	02-Aug-90	12	0	12
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
UNIT-2						
2EQBN001	*11-Oct-90	25-Oct-90	11-Oct-90	14	0	14
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
2EQBN002	*08-Oct-90	22-Oct-90	08-Oct-90	14	0	14
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
2EQBN003	*04-Oct-90	18-Oct-90	04-Oct-90	14	0	14
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
2EQBN004	*02-Oct-90	15-Oct-90	02-Oct-90	13	0	13
* Unavailability due to the implementation of Site Modification #SM-QD-007.						

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TABLE 3. Input Data and Calculated Known and Estimated Unavailable Days (continued)-

Equipment ID	Discovery Date	Repair Date	Last Known Available Date	Unavailable Known Days	Unavailable Estimated Days	Unavailable Total Days
UNIT-3						
3EQBN001	*12-June-90	20-June-90	12-June-90	8	0	8
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
3EQBN002	*02-Aug-90	17-Aug-90	02-Aug-90	15	0	15
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
3EQBN003	*16-June-90	19-June-90	16-June-90	3	0	3
* Unavailability due to the implementation of Site Modification #SM-QD-007.						
3EQBN004	*02-Aug-90	08-Aug-90	02-Aug-90	6	0	6
* Unavailability due to the implementation of Site Modification #SM-QD-007.						

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TABLE - 4

CALCULATION OF UNIT AND PLANT AVAILABILITIES (1991)

BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page 25
CHECKED BY: Sandra K. Guy	DATE: 08 Jan 92		JOB NO.: 13-NC-QB-200

TABLE 4: Calculation of Unit and Plant Availability

Equipment ID	Known Unavailable Days	Estimated Unavailable Days	Total Unavailable Days	*Required Days	Average Availability
UNIT-1					
1EQBN001	6	0	6	518	98.8%
1EQBN002	18	0	18	518	96.5%
1EQBN003	5	0	5	518	99.0%
1EQBN004	12	0	12	518	97.7%
Totals:	41	0	41	2072	
				Average Unit Availability:	98.0%
UNIT-2					
2EQBN001	14	0	14	518	97.3%
2EQBN002	14	0	14	518	97.3%
2EQBN003	14	0	14	518	97.3%
2EQBN004	13	0	13	518	97.5%
Totals:	55	0	55	2072	
				Average Unit Availability:	97.4%
UNIT-3					
3EQBN001	8	0	8	518	98.5%
3EQBN002	15	0	15	518	97.1%
3EQBN003	3	0	3	518	99.4%
3EQBN004	6	0	6	518	98.8%
Totals:	32	0	32	2072	
				Average Unit Availability:	98.5%
PALO VERDE PROJECT					
	128	0	128	6216	97.9%

* Required days 01 June 1990 through 01 November 1991 (518 days)

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TABLE - 5

AVAILABILITY COMPARISON

(1990 - 1991)

BY	DATE	SUBJECT	SHEET NO.
John R. Wadella JRW	06 Jan 92	CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	Page 27
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TABLE 5: Availability Comparison

Equipment ID	Previous Calculation June 1989 - June 1990	Present Calculation June 1990 - November 1991
1EQBN001	100.0%	98.8%
1EQBN002	95.1%	96.5%
1EQBN003	100.0%	99.0%
1EQBN004	100.0%	97.7%
UNIT AVERAGE:	98.8%%	98.0%
2EQBN001	82.9%	97.3%
2EQBN002	98.9%	97.3%
2EQBN003	100.0%	97.3%
2EQBN004	100.0%	97.5%
UNIT AVERAGE:	95.5%	97.4%
3EQBN001	92.9%	98.5%
3EQBN002	100.0%	97.1%
3EQBN003	58.7%	99.4%
3EQBN004	97.5%	98.8%
UNIT AVERAGE:	87.3%	98.5%
PVNGS PROJECT AVERAGE:	93.8%	97.9%

BY.	DATE:	SUBJECT:	SHEET NO.:
John R. Wadella	06 Jan 92	CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	Page 28
CHECKED BY: Sandra K. Guy SKG	DATE: 08 Jan 92		JOB NO.: 13-NC-QB-200

APPENDIX - B

WORK ORDER HISTORY GRAPHS

(1991)

ENGINEERING SKETCH PAD

REVISION 02

BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 29
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 1EQDNN05 (1EQBN001) TYPE: HOLOPHANE - UPS

Required available days : 518

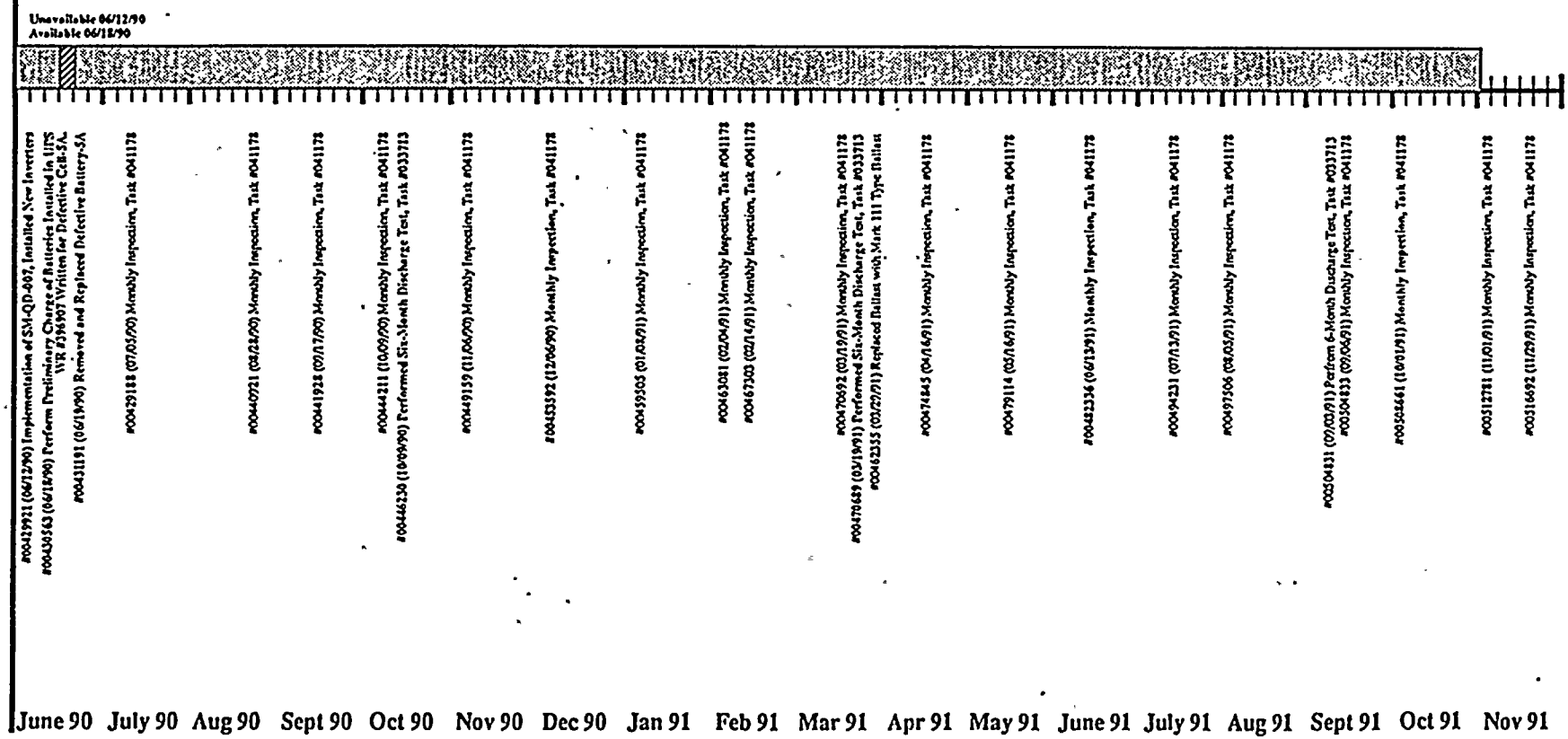
Known unavailable days : 6

Estimated unavailable days : 0

Available

Known unavailable

Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

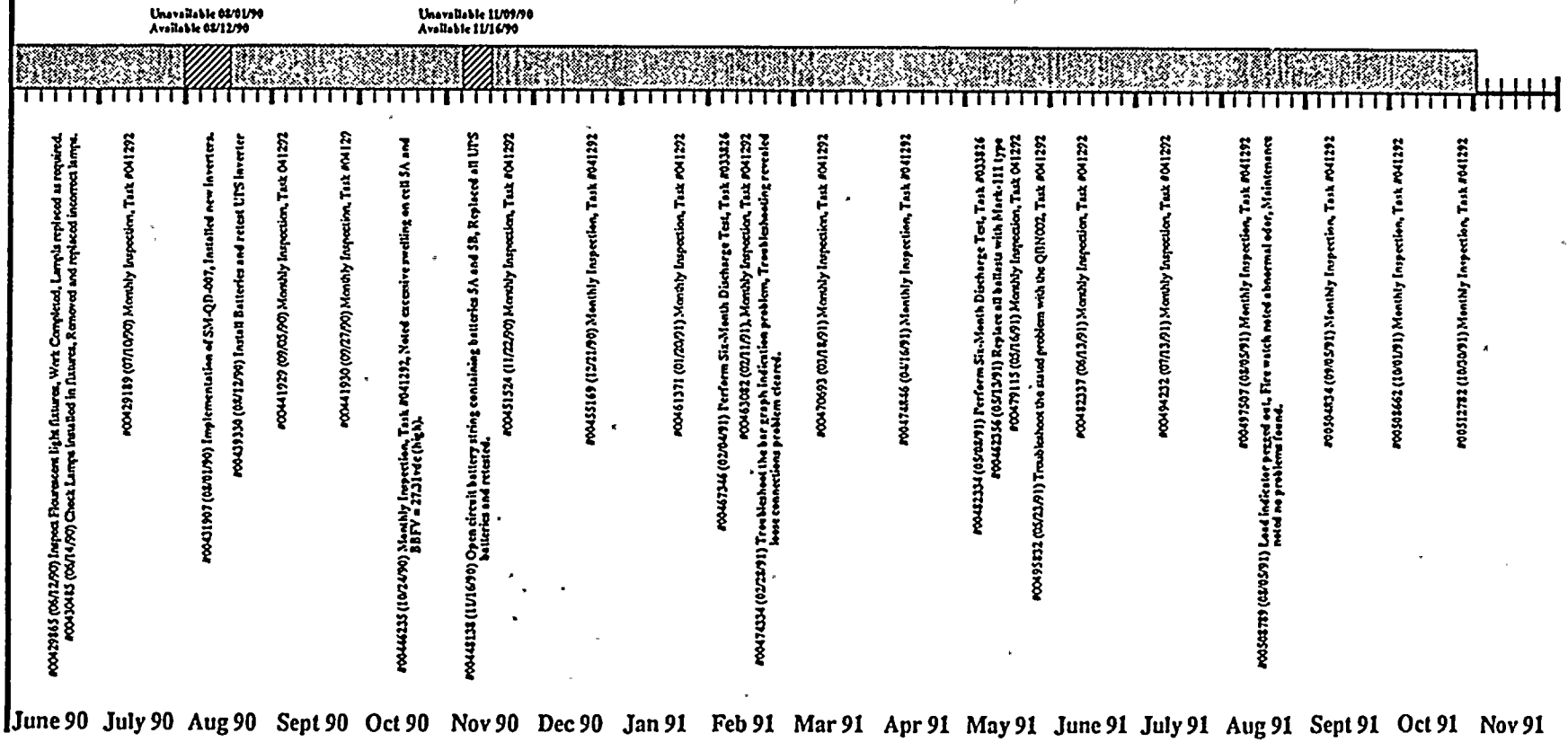
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 30
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 1EQDNN06 (1EQBN002) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 18
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

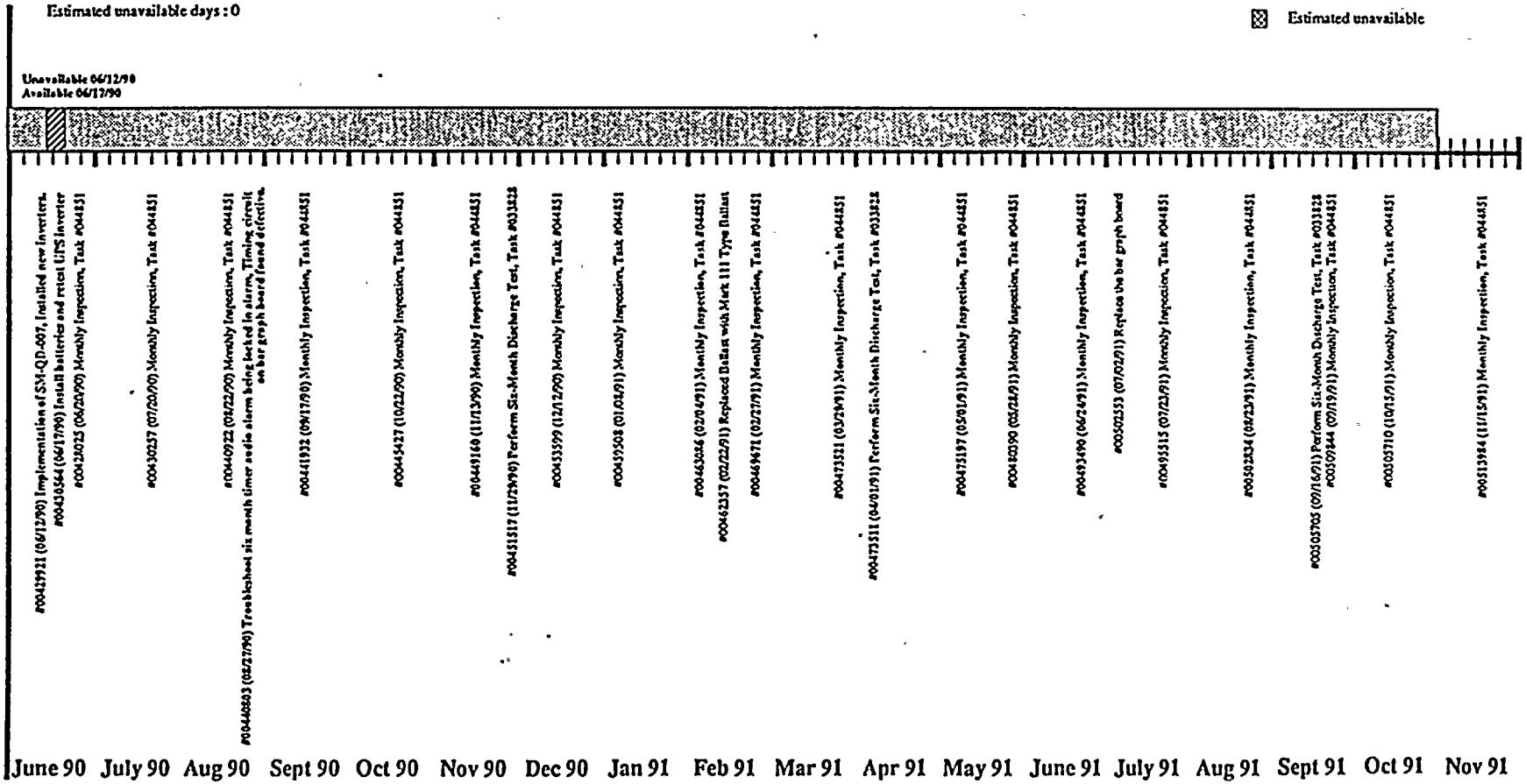
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 31
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 1EQDNN07 (1EQBN003) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 5
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 32
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 1EQDNN08 (1EQBN004) TYPE: HOLOPHANE - UPS

Required available days : 518

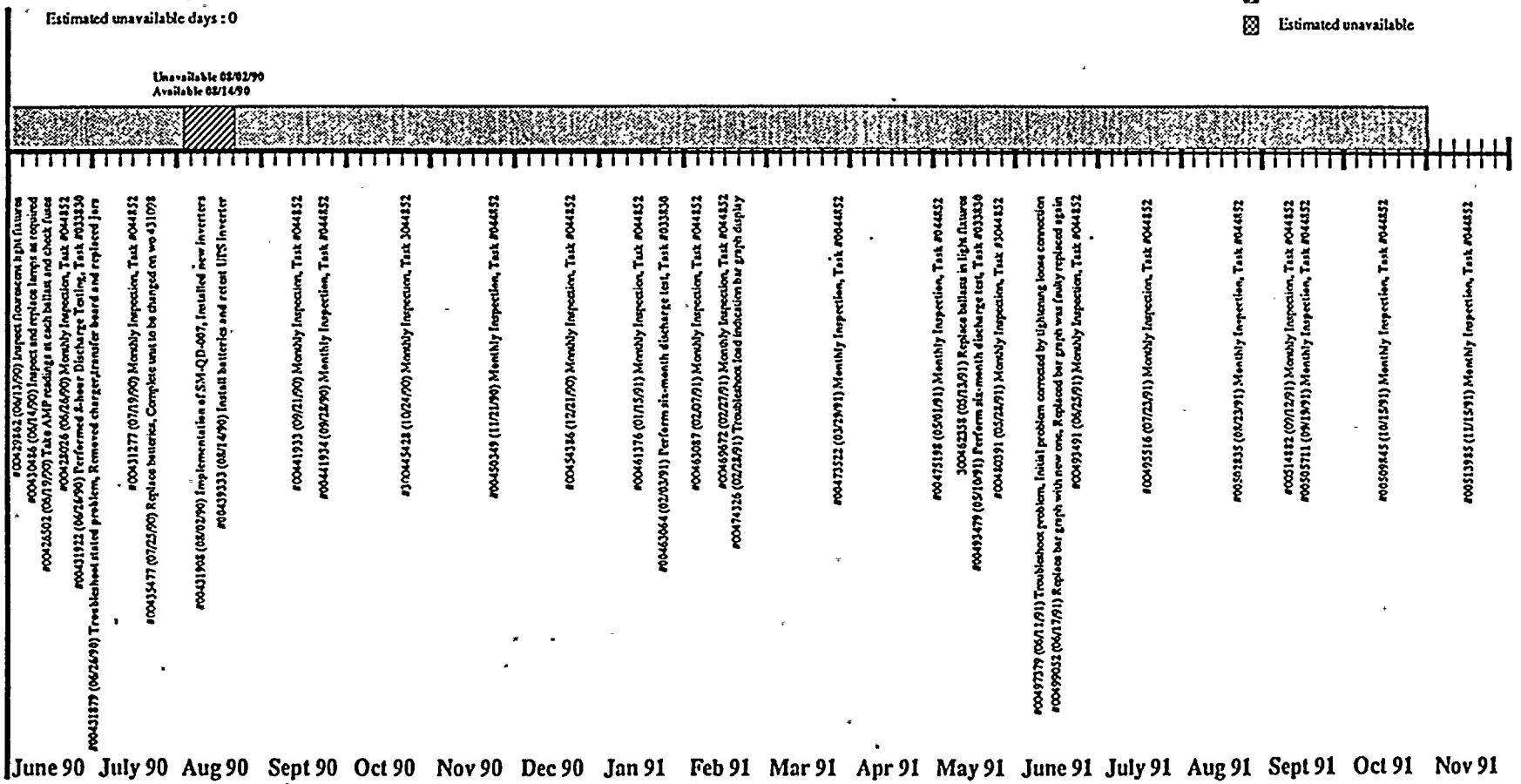
Known unavailable days : 12

Estimated unavailable days : 0

Available

Known unavailable

Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

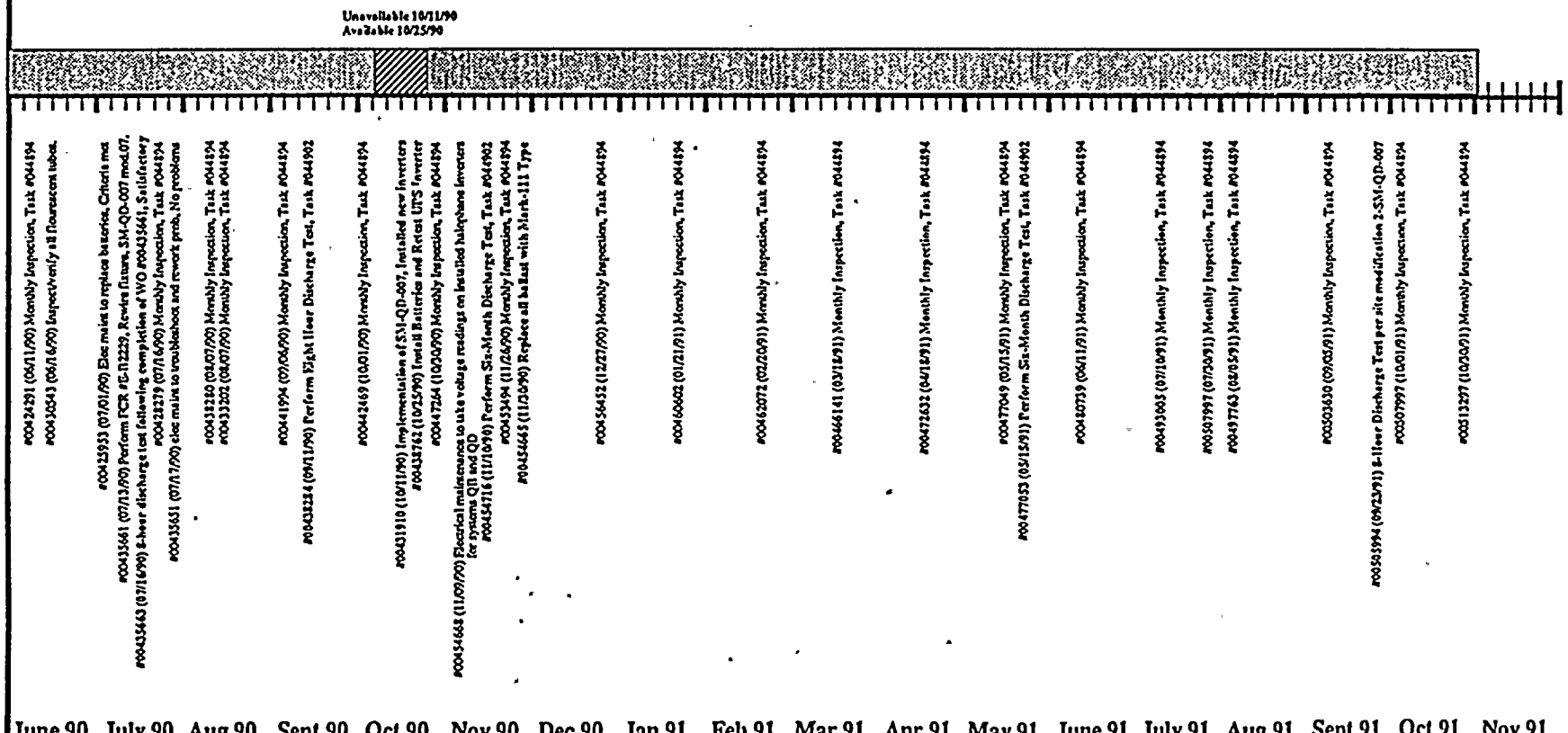
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 33
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 2EQDNN05 (2EQBN001) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 14
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

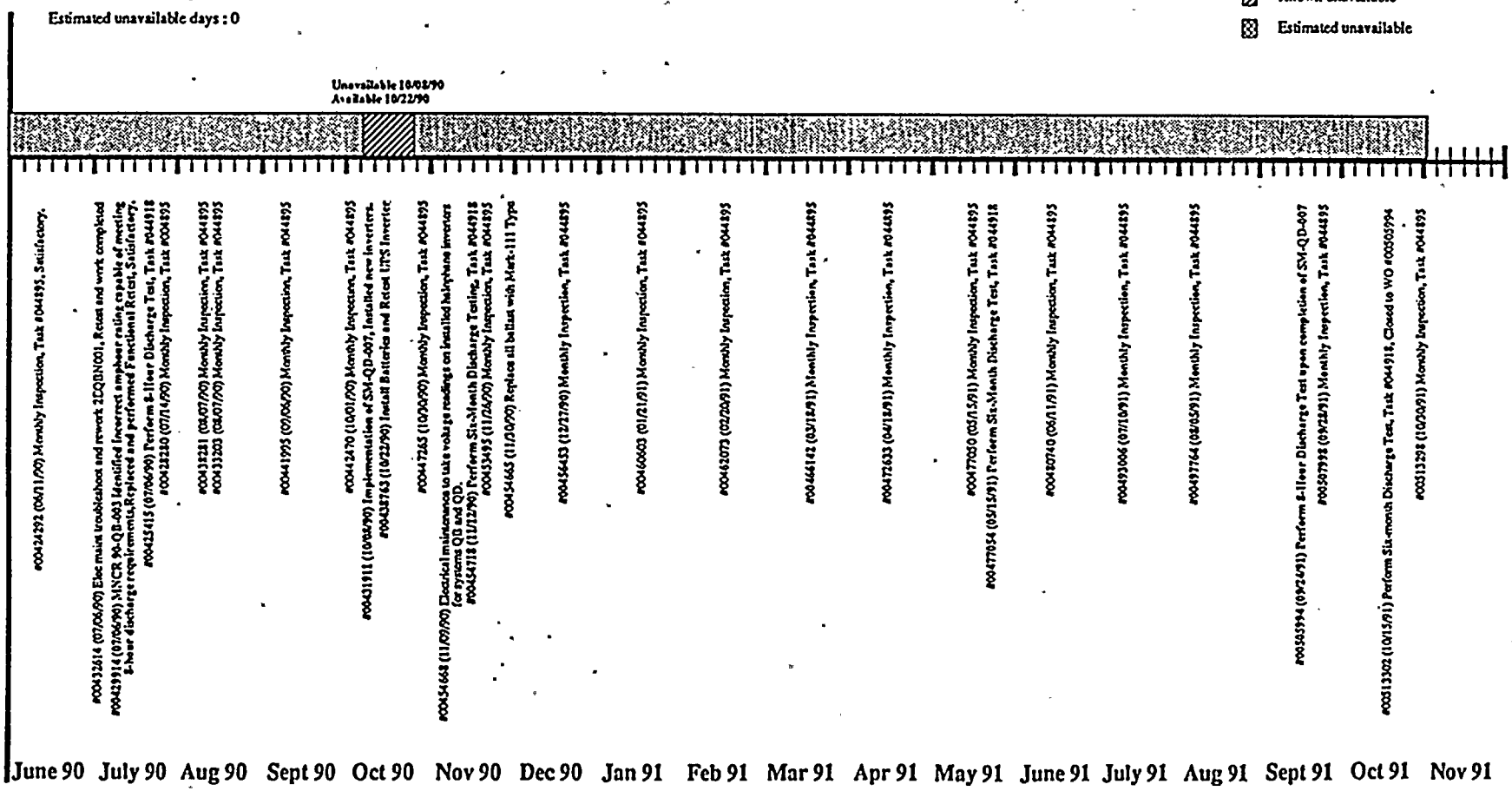
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 34
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 2EQDNN06 (2EQBN002) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 14
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

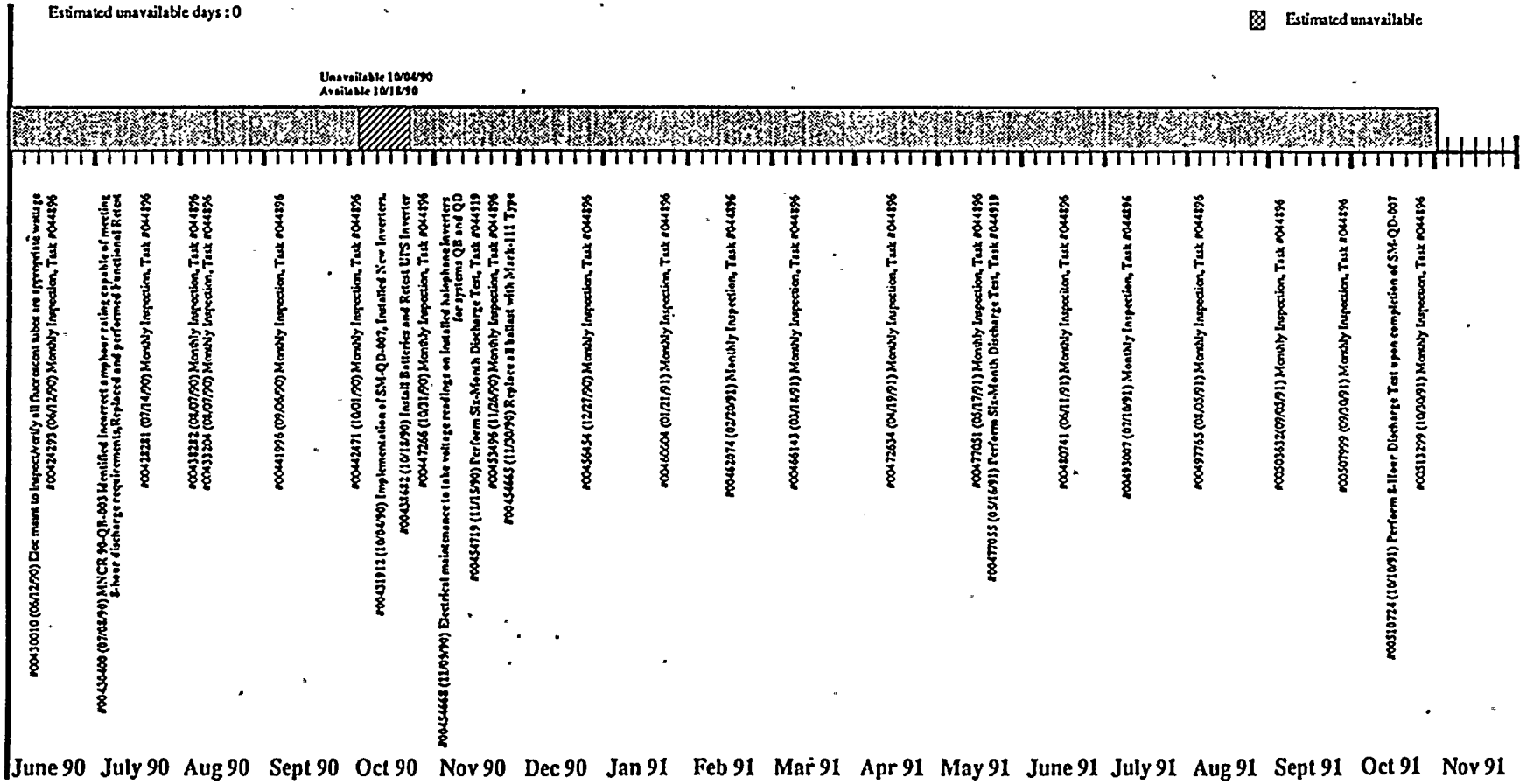
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 35
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 2EQDNN07 (2EQBN003) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 14
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 36
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID: 2EQDNN08 (2EQBN004) TYPE: HOLOPHANE - UPS

Required available days : 518

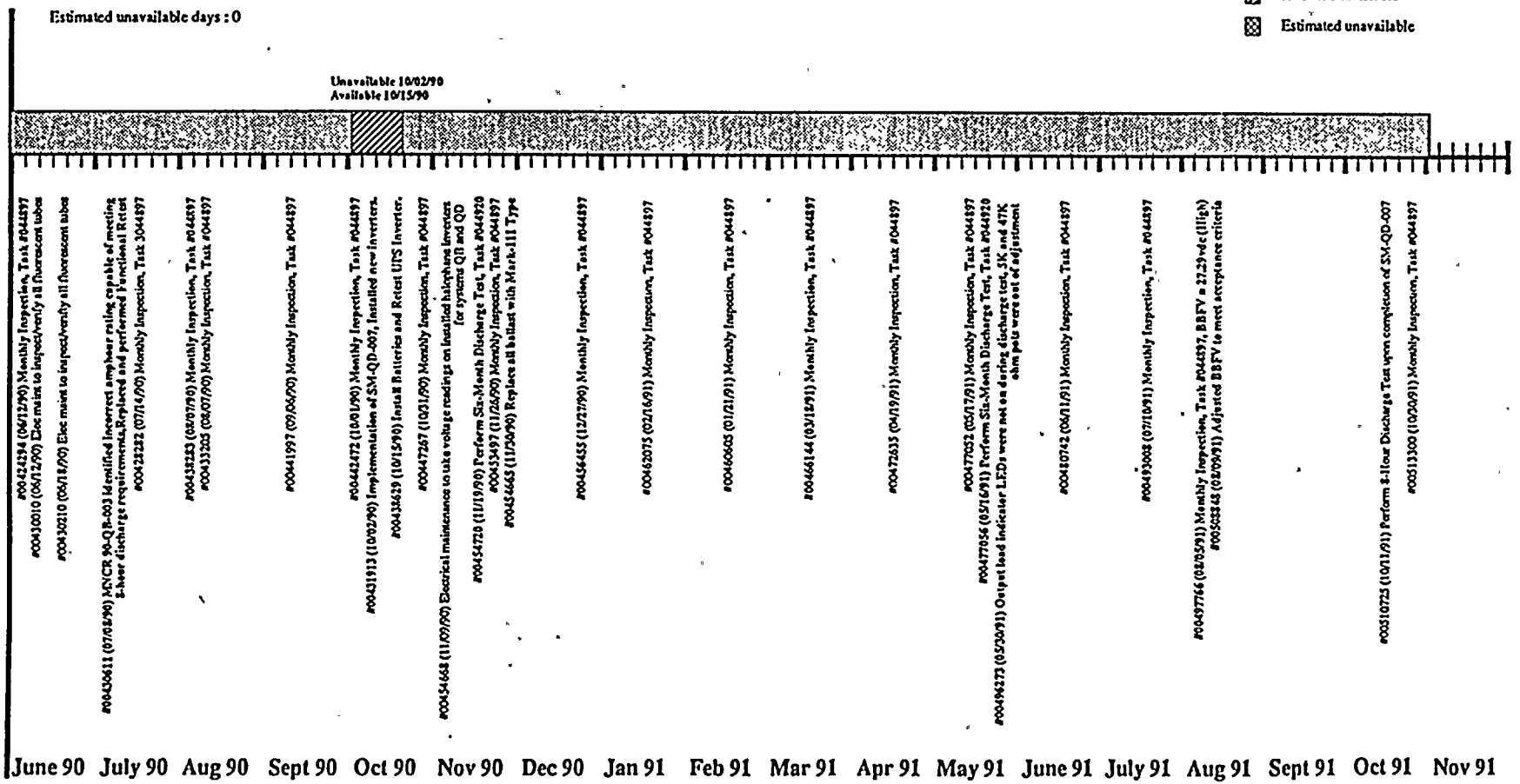
Known unavailable days : 13

Estimated unavailable days : 0

Available

Known unavailable

Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

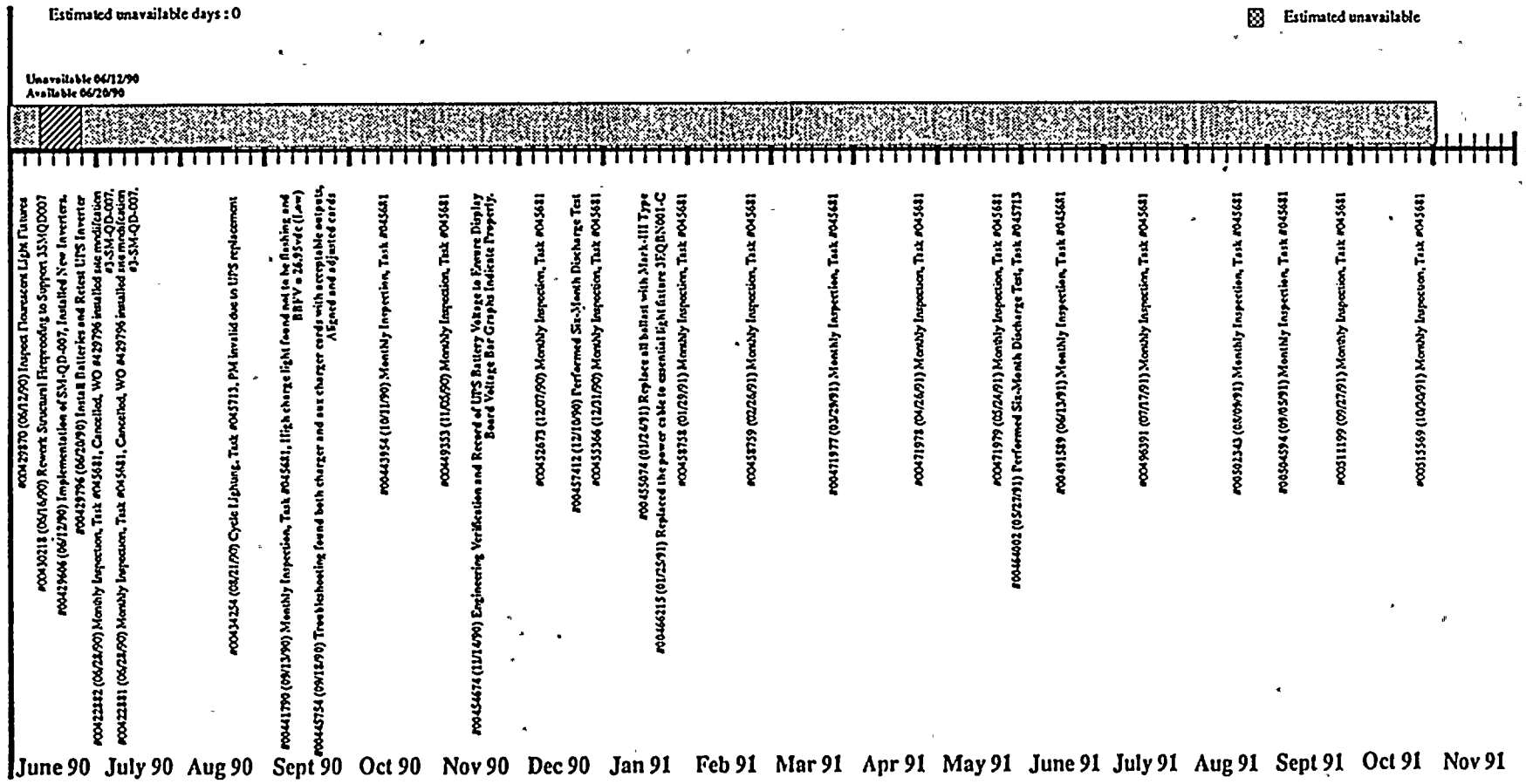
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF EXIDE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 37
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

Required available days : 518
Known unavailable days : 8
Estimated unavailable days : 0

EQUID: 3EQDNN05 (3EQBN001) TYPE: HOLOPHANE - UPS

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

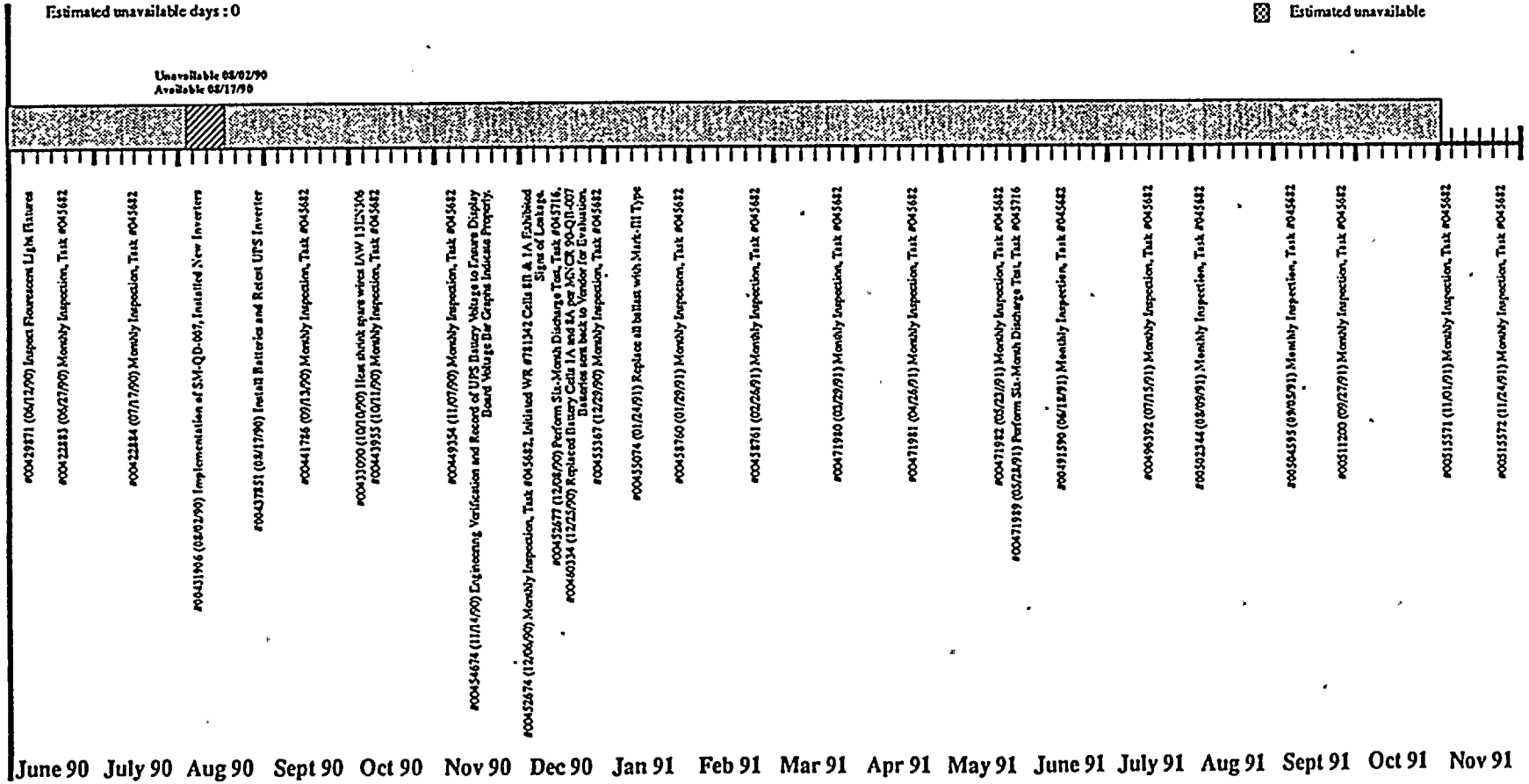
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 38
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID:3EQDNN06 (3EQBN002) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 15
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

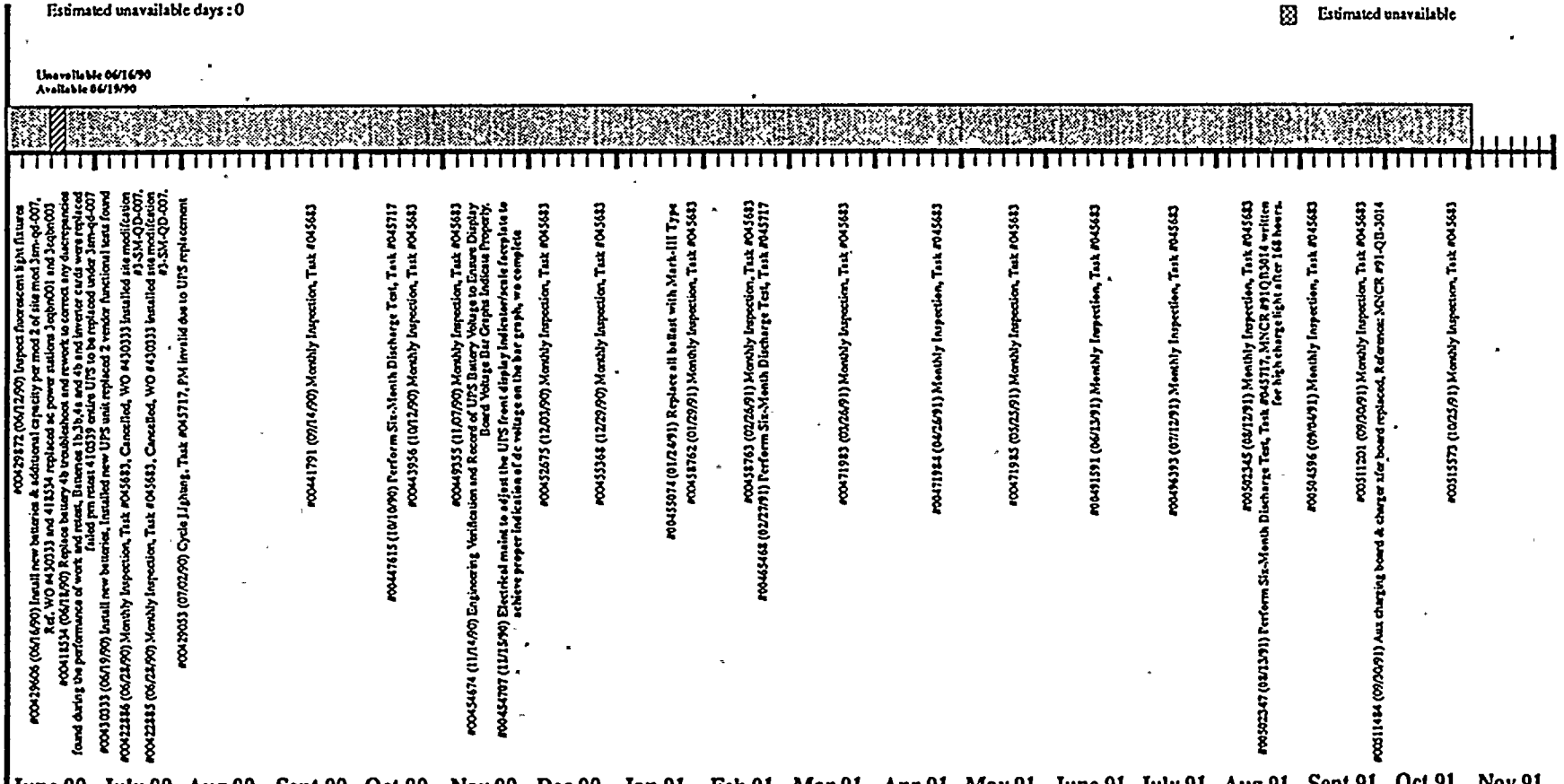
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 39
CHECKED BY: Craig A. Cooper	DATE: 1/15/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

EQUID:3EQDNN07 (3EQBN003) TYPE: HOLOPHANE - UPS

Required available days : 518
Known unavailable days : 3
Estimated unavailable days : 0

Available
Known unavailable
Estimated unavailable



ENGINEERING SKETCH PAD

REVISION 02

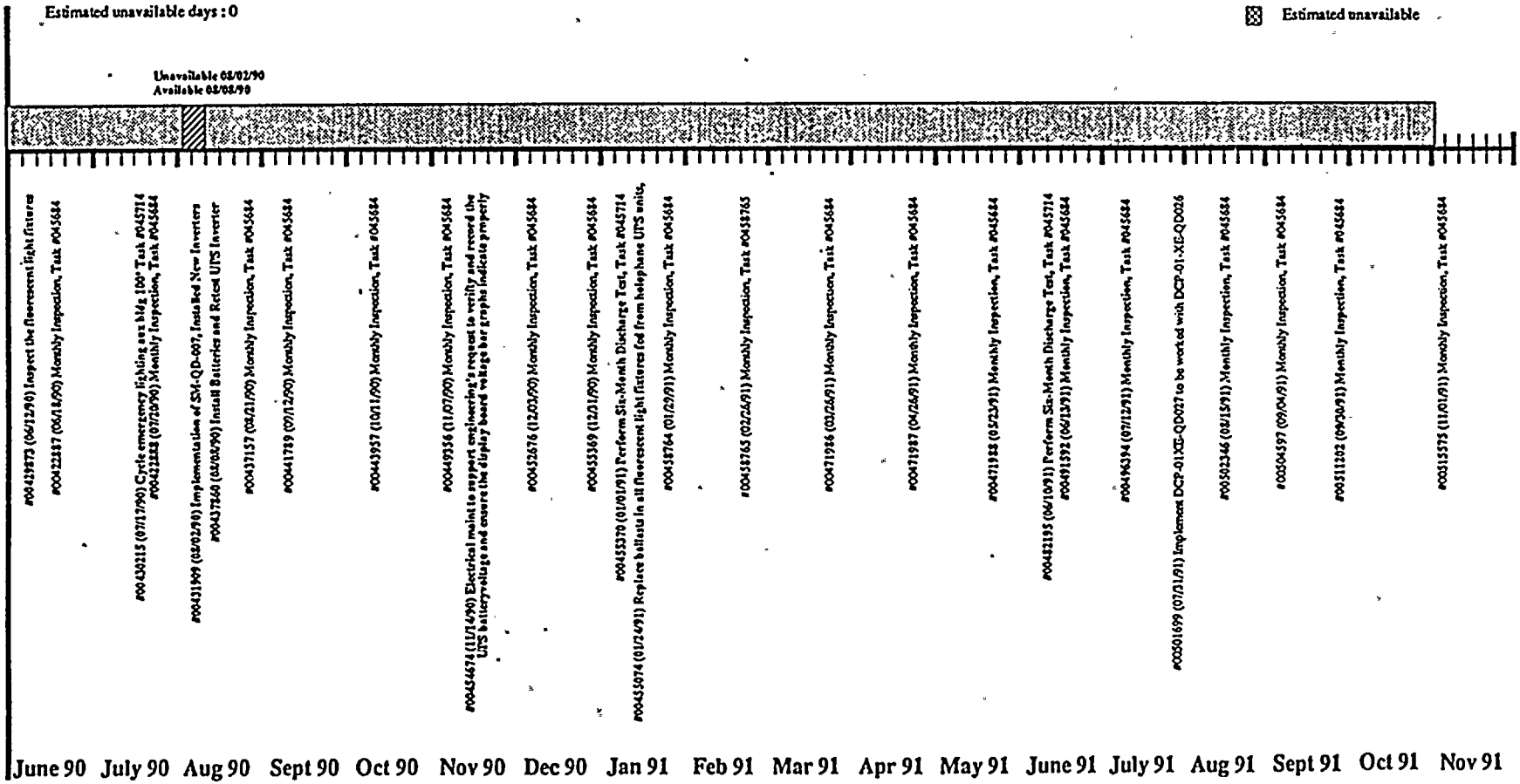
BY: John R. Wadella	DATE: 06 Jan 92	SUBJECT: CALCULATION OF HOLOPHANE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	SHEET NO.: Page: 40
CHECKED BY: Craig A. Cooper	DATE: 1/10/92		JOB NO.: 13-NC-QB-200

EMERGENCY LIGHTING COMPONENT AVAILABILITY

Required available days : 518
Known unavailable days : 6
Estimated unavailable days : 0

EQUID:3EQDNN08 (3EQBN004) TYPE: HOLOPHANE - UPS

Available
Known unavailable
Estimated unavailable



BY	DATE	SUBJECT	SHEET NO
John R. Wadella	06 Jan 92	CALCULATION OF EXIDE EMERGENCY LIGHTING UNITS AVAILABILITY (1991)	Page 22
CHECKED BY: Sandra K. Guy	DATE: 08 Jan 92		JOB NO.: 13-NC-QD-201

APPENDIX - B

WORK ORDER HISTORY GRAPHS

(1991)