Laboratory Services Series A Safety Shower Test and Maintenance Program

J. W. Fields H. F. Keese

MASTER

OAK RIDGE NATIONAL LABORATORY

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PLANT AND EQUIPMENT DIVISION

LABORATORY SERVICES SERIES
A SAFETY SHOWER TEST AND MAINTENANCE PROGRAM

J. W. Fields and H. F. Keesee

APRIL 1976

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LABORATORY SERVICES SERIES
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J. W. Fields and H. F. Keesee

ABSTRACT

Assuring reliable operation, when needed, of approximately 600 safety showers and eyewash fountains is an essential factor in an emergency preparedness program at any laboratory. Historical development and current practices of the ORNL safety-shower test program are described, including necessary personnel, equipment, and cataloging, scheduling, and testing techniques.

INTRODUCTION

Prior to about 1966, there was no organized program or method to determine the reliability of emergency safety showers or eyewash fountains. It is not apparent that anyone had a reasonable concept of the number of units in service. This was a matter of concern, not only to the potential users of these safety devices, but to safety officials and the management of the Plant and Equipment (P & E) Division.

Some attempts had been made by building occupants, members of the safety staff at the Laboratory, and Fire and Guard personnel, as they were available, to test showers. There were many problems encountered — absence of floor drains to remove the water, lack of a certification mechanism, insufficient personnel, and various deficiencies in the inspection techniques.

DEVELOPMENT OF THE TEST PROGRAM

As early as 1963, when the P & E Division's programmed-maintenance program (computerized preventive-maintenance scheduling) was initiated, an attempt was made to include safety shower heads in the inspection

program. Figure 1 is an early issue of the computer-printed programmed-maintenance schedule card. This initial scheduling effort proved ineffective, however, due to the absence of cataloging and other information necessary to ensure complete coverage of all units.

PROGRAMMED MAINTENANCE FOR WEEK OF SEPT 16, 1963						FOREMAN-- KIDWELL
LOCATION	EQUIPMENT DESCRIPTION				PROPERTY	JOB ORDER
0010--00-002 -	SAFETY SHOWER HEADS					
ITEM	POINT OF SERVICE	LUB	FTNG	NO	FREQ	REMARKS
1	CK OPERATION OF SAFETY SHOWERS				3M	
2	WORK IS TO BE DONE				3M	
3	IN COOPERATION WITH				3M	
4	INSPECTOR FROM THE				3M	
5	SAFETY DEPARTMENT				3M	

Fig. 1. Early computer-printed programmed-maintenance card.

In 1965, safety officials at the Laboratory and management of the P & E Division agreed to the following items in an attempt to resolve the problems:

1. A survey by a maintenance group of the P & E Division would be conducted, and all safety shower units would be located and cataloged.
2. Quarter-turn valves would be installed immediately upstream of the shower valve to permit instant shutoff of the water if the shower valve failed to close (a frequent occurrence). The ball valves would be wire-sealed in the open position with an instruction tag that a broken seal was to be reported to the Safety Department or maintenance group immediately upon discovery. This agreement modified a then-accepted premise that a shutoff device was not to be inserted in the line supplying a safety shower.
3. The maintenance group would conduct the initial survey and would install the ball valves.

4. The cost of the program would be charged to the Laboratory's building-maintenance account.

Eyewash units were added to the program in June 1969.

IMPLEMENTING THE TEST PROGRAM

The first consideration in surveying a facility as large as ORNL is establishing a means of identifying the showers as they are located. Identification was accomplished at ORNL by affixing a small permanent metal tag on the shower and entering that shower in the record log. Figure 2 shows a typical tag. The units were logged on log sheets (Figs. 3 and 4) with sufficient detail to locate the shower when the test program began. These log sheets were used in the first inspection cycle.

Fig. 2. Safety-shower identification tag.

Building Number	Room Number	Have Drain	Pipe Size to Shower	Approx. Distance from Shower to Drain	Delicate Inst.	Location of Cut-off Valve
4510	W. end between cooling towers by acid tank	No	1-1/2" - 1"		None	2' W. of shower underground
4500-S	H-247	No	1"		None	Process H ₂ O valve overhead and 7' N. of door in Room G-47
4500-S	H-corridor at H-256 door	No	1"		None	Process H ₂ O valve overhead in N.W. corner of Machine shop in basement Wing 4
4500-S	G-263	No	1"		None	Process H ₂ O valve overhead and 20' N. inside G-63 door next to column
4500-S	G-259	No	1"		None	Process H ₂ O valve overhead and center of 2 center columns on w. wall in machine shop, basement, wing 4
4500-S	G-corridor at G-256 door	No	1"		None	Process H ₂ O valve overhead in N.W. corner of Machine shop in basement Wing 4
4500-S	R-corridor 15' W. of R-215 door	No	1"		None	Overhead 12' W. 4' S. at column in E. end of Room W-2 (East R-115) (Chase R-215)
4500-S	F-263	No	1"		None	Process H ₂ O Valve above false ceiling midst of Room F-63 at W. wall
4500-S	F-259	No	1"		None	Process valve above false ceiling in S.W. corner of N. room of F-59
4500-S	F-corridor at F-254 door	No	1"		None	Process H ₂ O valve above false ceiling in middle of Room F-51 at W. wall
4500-S	F-251	No	1"		None	Process valve above false ceiling midst of Room F-55 at W. wall
4500-S	F-247	No	1"		None	Process valve above false ceiling in midst of F-47 at W. wall

Fig. 3. Catalog of safety-shower locations.

SAFETY SHOWER INSPECTION					
Building Number	Safety Shower No.	Location	Shut-off Valve Seal	Inspect. Date	Comments
RJR	3004	57 N.S. of SE. Door	✓ No. 804	1/17/18	Contact - L.P. Jennings
	3004	58 O.S. - N.W. Corner	✓ " "	1/17/18	B-3042 Paint
	3004	59 I.S. - East of N. Door	✓ " "	1/17/18	
	3004	60 2nd Fl. West Side	✓ " "	1/17/18	Ch. 178 - removed - this is removed
	3042	540 Col. D-5 First Floor		5/17	
RJR	3042	61 Col. B-6 - Basement	✓	1/17	Contact - R.K. Brantam
	3042	62 So. Col. B-6 - Basement	✓	1/17	Ext. 36451
	3042	63 Loop #2	✓	1/17	
	3042	64 D-2 Col. - First Floor		1/17	
	3042	65 Col. D-5 First Floor			
	3012	560 N.W. End	✓	1/17	Contact - J. Erwin or H. Wallace
RJR	3086	65 Inside Shed Tower	✓	1/17	Contact - R.K. Brantam
					Ext. 36451
RJR	3085	66 Inside door for Pump #3	✓	1/17	Contact - R.K. Brantam
	3085	67 " " " " #2	✓	1/17	Ext. 36451
	3085	68 " " " " #1	✓	1/17	
	3119	561 Near East Door	✓	1/17	Contact - J. Howe B-3025
RJR	3103	69 N.W. S.E. Corner - Outside	•	1/17	Contact - R.K. Brantam
					Ext. 36451
WE. 1/21	3025	70 Near M-212	✓ ✓	1/18	Contact - Call Operators
	3025	71 " ML-203A	✓ ✓	1/18	Cell area
	3025	72 " M-312	✓ ✓	1/18	Contact - J. Howe B. Busby
	3025	73 " M-311	✓ ✓	1/18	Main Bldg.
	3025	74 W. End Hal Cell #3	✓ ✓	1/18	
	3023	75 W-4 Tank			removed Request to be removed by Call 36234 Shift Operator by 11:00 AM
	3026-D	76 S.W. Door Rm #5	✓ ✓	1/18	Contact - AA. Walls
	3026-D	77 Near Entr. Disch. Rm.	✓ ✓	1/18	East End ("D" Bldg.)
	3026-D	78 Centron Area Above Cells	✓ ✓	1/18	Contact - Ron Haase
	3026-D	79 SW Corner "D" Bldg. N. of Door to Rm #30	✓ ✓	1/19	West End ("C" Bldg.)
	3026-C	80 S.S. - 2nd Floor	✓ ✓	1/18	Paint needed
	3026-C	81 O.S. Rm #7	✓ ✓	1/18	Paint needed
	3026-C	82 I.S. East of S.W. Lab	✓ ✓	1/18	
	3026-D	562 over Cell East End	✓	1/19	

Fig. 4. Initial catalog of safety-shower locations and test record.

As additional experience was gained in the test program, it became apparent that some type of on-floor identification of a safety-shower zone was needed because of the recurring problem of finding the shower blocked by various materials stored under the shower head. Thus, a safety-shower symbol was devised and painted on the floor immediately under the shower. This symbol is shown in Fig. 5. Painting of these symbols was completed in 1970.

Fig. 5. Safety-shower floor symbol.

A validation tag (Fig. 6) was devised, and one was affixed to each shower installation to be signed and dated at the time of each test.

Initially, the test frequency was established as quarterly. Due to favorable experience on a quarterly cycle, the frequency was extended to semiannually in early 1970. Experience with the six-month cycle again was favorable, and finally, in 1971, the test frequency was extended to one year, where it remains.

TEST PROCEDURE

The shower test involves the use of a 55-gal drum mounted on four soft rubber wheels. The drum is equipped with a valve and drain pipe so that it may be drained after each shower is tested. A clear polyethylene containment sleeve is affixed around the shower head. The open end

Fig. 6. Validation tag.

is inserted in the portable drum in such a manner that the discharged water is contained within the sleeve and the drum. Figure 7 shows the drum in use.

The test involves activating the shower valve and observing whether the valve opens and closes correctly, whether there are leaks, and whether the water is clear (free of rust and scale). The quantity of water discharged is observed from which the adequacy of flush duration can be judged. A visual inspection is made of the installation. The actuating device is inspected for defects; the condition of the safety-shower symbol is noted; and the safety-shower location light, if the shower is equipped with one, is checked to see if it needs relamping.

Minor repairs are accomplished on-site. In cases requiring more than minor repair, the defective component is replaced and the repair of the removed component is accomplished at a workbench. When testing of each unit is completed, the journeyman signs and dates the validation tag that is affixed to the unit.

Fig. 7. Test drum and containment sleeve in use.

Eyewash units are operated manually, and the journeyman inspector makes a complete visual examination of the results. Figure 8 shows a properly operating eyewash unit.

Fig. 8. Properly operating eyewash unit.

The personnel complement required to accomplish the safety-shower test is one journeyman pipefitter and one laborer, who acts as an assistant. Labor requirements have declined since the first test cycle in 1968. It was discovered in 1976 that the chain and ring assembly was not in keeping with an existing technical specification (UCC-ND Engineering Standard Y-ES-4.11-1), and, in the course of the inspections, the pull chain was changed to agree with that specification.

The time required to conduct the tests has declined from approximately 40 crew-days for the initial tests to approximately 16 crew-days for the 1975 inspection.

PROGRAM PROBLEMS

The most difficult part of establishing this test program was the installation of the ball valves. A large number of the showers are supplied directly from the building water supply without isolating valves. It had been feared that isolation valves would be closed, rendering the safety shower inoperative when needed. Initially, our approach to installing the ball valves was a complete building water shutdown. This effort proved to be very difficult or, in many cases, impossible because of the vast number of ongoing research projects that could not be disturbed by a water shutdown. In any case, the approval of large numbers of research and operating personnel was required prior to building shutdowns.

It finally became necessary to resort to an old but expensive trick and employ a "freeze box," shown in Fig. 9. The interior of this device is filled with solid carbon dioxide (dry ice) and clamped around the pipe. In due time, the line is frozen and may be cut downstream of the box without affecting the service to the rest of the facility.

An additional problem frequently encountered is the propensity of the building occupants to hang the pull ring that activates the valve up over the valve lever, thus, in effect, rendering the device useless in the event of an emergency. This condition is simulated in Fig. 10. Apparently, this is done to prevent the pull ring from interfering with activities under the shower.

Fig. 9. Freeze box.

Fig. 10. Improperly stored pull ring.

Figure 11 shows the conversion of the ring and chain to nylon lanyard, as required by existing technical specifications. Figure 12 shows the shower with nylon lanyard pull rope and validation tag affixed.

Fig. 11. Conversion from pull ring to nylon lanyard.

Fig. 12. Converted unit with nylon lanyard and validation tag.

PROGRAM COSTS

Complete cost information is available since the inception of the program. Table 1 contains the details of the program by test cycles. The number of safety showers, eyewash units, items repaired, labor requirements, and cost per unit per test is given. Material costs have been minor.

Attention is invited to the general decline in unit costs before the 1976 cycle. Costs for CY-1976 were increased due to the need to alter the pull chain to conform with an existing technical specification. The decline becomes even more significant when considered with the increase in wage rates over the period of the program. The decline may be attributed to increasing familiarity with the test program by the workmen and supervision as required actions become more routine (e.g., location of shower units and water disposal points).

Figure 13 contains a graphic presentation of the basic data shown in Table 1.

SCHEDULING, VALIDATING, AND HISTORY

The safety-shower test program has been incorporated into the P & E Division's computerized maintenance-scheduling program (programmed maintenance).

The electronic data-processing (EDP) equipment prints the schedule cards during the last workweek of the year. Figure 14 is a specimen card. The card lists three units that are located in Building 3505. In this case, one unit had been removed from service, and the workman so indicated on the face of the card.

As the inspections are completed, an Equipment Maintenance Record card (Fig. 15) is completed for each schedule card. In this case, a preprinted card was used since the two items checked — visual inspection and check operation — adequately describe the test work done. In addition, a Supplemental Equipment Maintenance Record card (Fig. 16) was prepared which removed Unit No. 130 from the program.

Table 1. Cost details

Cycle	Date	No. of showers		No. of eyewash units		No. of valves replaced	No. of valves repaired in field	Rings replaced	Man-hours required	Labor cost/unit
		Known	Tested	Known	Tested					
1	4/68	542	542	0	0	N.A.	N.A.	N.A.	638	\$4.80(est.)
2	7/68	545	545	0	0	18	12	22	421	2.75
3	1/69	544	543	44	44	10	18	3	472	2.68
4	7/69	529	526	44	44	9	0	6	402	2.44
5	1/70	534	532	45	45	10	0	0	417	2.57
6	7/70	531	526	46	46	16	2	0	477	3.09
7	1/71	532	525	46	46	2	5	2	350	2.28
8	1/72	554	543	45	45	3	0	1	365	2.49
9	1/73	546	536	50	49	6	9	1	348	2.54
10	1/74	545	537	51	50	6	0	2	302	2.30
11	1/75	533	526	57	56	6	0	0	255	2.15
12	1/76	532	530	61	61	1	0	263	305*	2.78*

*This cost reflects both the rate increase of June 1975 and replacing 263 pull chains with nylon rope pulls.

Fig. 13. Number of units and test unit cost vs date of test cycle.

PROGRAMMED MAINTENANCE FOR WEEK OF DEC 30, 1974			FOREMAN	FIELDS
LOCATION 3505- 99 200: SHOWER, SAFETY			QUALITY LEVEL 3	
EQUIPMENT DESCRIPTION		PROPERTY	JOB ORDER	
			60221E-	
ITEM	POINT OF SERVICE	LUB FTNG NO	FREQ	REMARKS
1	CK OPERATING CONDITION		Y	---CONTACT---
2	REPORT BURNED OUT LIGHTS		Y	SHIFT OPERATOR
3	REPORT CONDITION OF SYMBOL		Y	EXT. 3-6234
4	# 127 W. SIDE NEAR CAUSTIC TANK		Y	
5	# 129 INSIDE S.E. DOOR		Y	
6	# 130 U.S., S.W. DOOR delete delete		Y	

Item 6 - Removed 2-0

Fig. 14. Current computer-printed programmed-maintenance card.

PROG. MAINTENANCE NUMBER			EQUIPMENT MAINTENANCE RECORD		DATE ON PROG. MAINT. CARD	
3505- 99 200					123074	
ALDG. ROUTE LOC.						
11 ☐ GREASE ADDED	21 ☐ TRAP CHECKED	31 ☒ VISUAL INSP	41 ☐ BRAKES CHECKED	PROG. MAINTENANCE ☒		
12 ☐ OIL CHECKED	22 ☐ TRAP REPAIRED	32 ☐ CONTROLS CKD	42 ☐ BRAKES ADJ	REPAIR ☐		
13 ☐ OIL ADDED	23 ☐ FILTER CHECKED	33 ☐ BATTERY SPG	43 ☐ CONTRL VLVE ADJ	TOTAL MANHOURS		
14 ☐ OIL CHANGED	24 ☐ FILTER CLEANED	34 ☐ WATER ADDED	44 ☐ CHECK BRUSHES	59 HOURS 1 15 MIN. 61		
15 ☐ BELT CHECKED	25 ☐ FILTER REPLACED	35 ☐ BATTERY REPL	45 ☐ REPLACE BRUSHES	DATE COMPLETED		
16 ☐ BELT ADJUSTED	26 ☐ PACKING ADJ	36 ☐ SWITCH CHECKED	46 ☒ CK OPERATION	011574		
17 ☐ BELT REPLACED	27 ☐ GLAND REPACKED	37 ☐ SWITCH REPAIRED	47 ☐ LEAK TEST	MATERIAL COST		
18 ☐ STRAINER CLND	28 ☐ DRAINED WATER	38 ☐ SWITCH REPLACED	48 ☐ CHEM TREATMENT	75 76 77 78		
19 ☐ DIRT LEG CLND	29 ☐ CHECKED REFRIG	39 ☐ CK FLEX DUCT	49 ☐ CK GLYCOL CONT	INITIALS		
20 ☐ EQUIPMENT CLND	30 ☐ REFRIG ADDED	40 ☐ TEST RUN	50 ☐ REPAIR LEAKS	JWF		
				PUNCH 2 IN COL. 80		

Fig. 15. Equipment Maintenance Record card.

PROG. MAINTENANCE NUMBER 1 3 5 0 5 - 5 9 9 2 0 0 BLDG. ROUTE LOC. 10										EQUIPMENT MAINTENANCE RECORD										DATE ON PROG. MAINT. CARD 51 1 2 3 0 7 4 56																			
11 ADDITIONAL MAINTENANCE INFORMATION S S N O 1 3 0 d e l e t e d										57 PROG. MAINTENANCE ☒										58 REPAIR ☐																			
49										59 TIME ON THIS JOB-TOTAL MANHRS. HOURS MIN.										63																			
50 ☐ EQUIPMENT NOT SERVICED THIS TIME										64 DATE COMPLETED 0 1 1 5 7 4 69										MATERIAL COST 70										74									
UCN-10046B (3 11-73)										75 INITIALS J W F 77										PUNCH 4 IN COLUMN 80																			
SEE OTHER SIDE FOR INSTRUCTIONS																																							

Fig. 16. Supplemental Equipment Maintenance Record card.

As each unit is successfully tested, the mechanic signs and dates the validating record card affixed to the shower as shown in Fig. 17. In this case, he is certifying that the unit functioned properly on the date of the inspection.

Fig. 17. Test validation.

The information supplied by the Equipment Maintenance Record Card is accepted by the computer and may be recalled at any time via a remote-access terminal to the central EDP facilities. Figure 18 is a local-terminal printout of the history contained in the EDP maintenance file for the units enumerated in the schedule file.

ADMINISTRATIVE CONTROLS

Inspection responsibility has been assigned to one maintenance group for the total Laboratory. This group is responsible for exerting all reasonable effort to ensure that all units are included in the inspection program.

To assure that responsible supervision is made aware of changes, safety showers and eyewash units are removed from service only when written approval is received from a responsible facility supervisor or a P & E Division field engineer.

Additional units are included in the program when reported to the maintenance supervisor responsible for the inspection program or when unreported units are located as the annual inspection is being made.

As will be noted in the tabulation, a few units are not inspected due to a variety of reasons, such as rooms being locked, equipment blocking access to the unit, or the close proximity of high-voltage equipment. In those cases, additional effort is required to obtain approval to conduct the tests. In each situation where additional effort to test the unit is unsuccessful, the facility supervisor and the P & E Division field engineer are notified that the unit was not inspected.

RESULTS AND CONCLUSIONS

All units have functioned properly when activated. Occasionally, a shower valve will fail to reclose properly due to a variety of reasons, such as accumulated debris and scale or a malfunctioning of valve mechanisms that require the use of the ball valve to prevent flooding an area. As a general rule, repairs are simple and can be accomplished at the site.

POLLSTRTPED 13.59.246960														
/chrg 6769														
CHARGE 6769 ENTERED.														
\$pmaint														
3505-9920001														
\$														
PMAINT 0003.37														
3505-9920001														
\$														
2 HISTORY RECORDS AVAILABLE														
RUN DATE 03/12/76														
.....CUMULATIVE TO DATE.....														
P.M. NUMBER		DESCRIPTION				WORK ORDER		FOREMAN		HOURS		MATERIAL COST		
3505-99200		SHOWER, SAFETY				G0221E-		FIELDS		2.0		0		
.....DATE.....														
SCHEDULED		COMPLETED		BADGE	WORK TYPE	HOURS	MATERIAL COST		WORK PERFORMED					
01-01-73		01-24-73		14071	PROG MAINT	1.0	0		VISUAL INSP		TEST RUN		CK OPERATION	
						LEAK TEST								
12-30-74		02-05-75		EJG	PROG MAINT	2.0	0		VISUAL INSP		TEST RUN		CK OPERATION	
						LEAK TEST								
PMAINT 0003.27														

Fig. 18. Local-terminal printout of inspection history for two safety showers.

Initial inspection costs can be relatively high when compared with costs later in the program, due to the need to search out and catalog the units. As a program develops and the workmen involved gain experience and familiarity with the details of the program, costs will decline.

An annual cycle appears adequate to ensure the reliability of safety-shower units.

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