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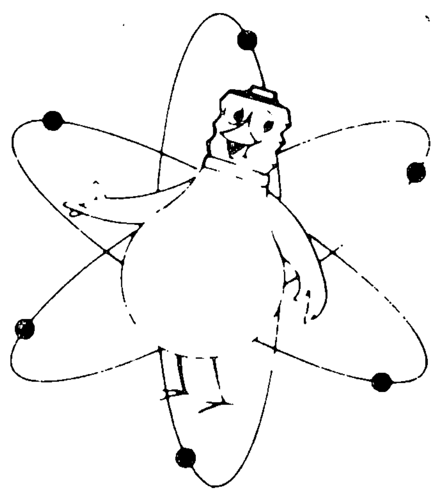
DRESDEN NUCLEAR POWER STATION
UNIT 2

Special Reports

March 17, 1971



Commonwealth Edison
Company

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REPORT NO. 1

VIBRATION CRITERIA

FOR

JET PUMP SUPPORTS

March 17, 1971

Commonwealth Edison Company

REPORT NO. 1

Comments

A description of your plans or actions to assure safe operation until new vibration criteria are justified for the jet pump supports.

Response

A discussion of the purpose, scope, and results of the General Electric BWR internals vibration testing program to date has been submitted in Quad-Cities FSAR Amendments 16, 17, and 19. In particular, Amendment 19 contains detailed test results on the Dresden-2 jet pump riser brace which shows that the previously established steady state vibration criteria are exceeded for brief periods when the recirculation pumps are at considerably dissimilar speeds. Since the steady state criteria were developed based on a conservative fatigue life evaluation for continuous, 40-year operation (2 x 10^{10} cycles at 20 Hz), they are not applicable to infrequent transient conditions.* However, the same basic fatigue analysis can be performed for infrequent transient conditions, and similarly conservative criteria established, using a fatigue life curve of alternating stress vs. number of cycles to crack initiation. In other words, similarly conservative margins below any fatigue crack initiation condition can be maintained at a higher stress level if a fewer number of cycles is sustained. Such an analysis has been completed for the Dresden-2 jet pump riser braces and has also been reported in detail in Quad-Cities FSAR Amendment #19, together with vibration tests of an actual riser brace assembly, in order to firmly establish the new criteria.

With the new criteria thus established for infrequent transient conditions corresponding to a particular unbalance in pump speeds, fatigue life usage factors corresponding to such operating conditions can be evaluated.** This is shown on Page 46 of the referenced Amendment 19. One-pump restarts are shown as the major contributors to such usage and these have been prohibited by operating procedure. Operating procedures also prohibit a significant speed mismatch between the two pumps during normal operations. Finally, one-pump trips are acceptable because they are not a major contributor to fatigue life usage (i.e., frequency and usage factors are low).

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* i.e., if the steady state criteria are met for infrequent transient conditions, fatigue life usage in 40 years would be approximately zero.

** One pump has to be about double the speed of the other before a significant increase in usage factor results. The speed of both pumps is indicated in the control room.

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However, recognizing that procedures can be violated inadvertently, further assurances will be provided by installation of automatic features which will:

1. sound alarms if operational changes occur where the undesired operating regions are approached,

2. provide positive interlocks on pump speed controls to prevent entry into these regions, and

3. prevent restart of one pump when the speed of the operating pump is too high.

Thus, new amplitude criteria (converted to fatigue life usage) have been established for unbalanced recirculation pump operation and the means of remaining substantially below these criteria have been implemented.

In addition to verify the braces integrity, the braces will be inspected during the refueling outages in accordance with the technical specification requirements.

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REPORT NO. 2

MINIMIZE OR ELIMINATION OF VENTING

March 17, 1971

Commonwealth Edison Company

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REPORT No. 2

Comment

Your evaluation of the proposed methods to either minimize or to eliminate the need for periodic venting of the containment during normal plant operations.

Response

Dresden 2 was periodically vented to reduce pressure buildup in the containment. The frequency of venting appeared to be excessive so a detailed review and evaluation was conducted to determine the possible sources for air leakage into the containment. This review and evaluation revealed the following discrepancies: 1) a broken tubing fitting and a leaking diaphragm operator on a ventilation control damper in the instrument air system, and 2) the TIP purge system was using 620 scf/day, about 4 times the maximum design value of 150 scf/day due to an improperly set purge flow regulator. After correcting these discrepancies, the pressure rise in the containment was reduced thereby reducing the venting frequency from once every 2-3 days to once every 5-6 days (based on reducing pressure from 0.8 to 0 psig) thus minimizing periodic venting.

The remaining venting is required by a leakage of approximately 1 scfm into the containment from pneumatic equipment which is within the expected leakage rates from this equipment.

It is not possible to totally eliminate the need to vent. Venting will always be required during heat-up of the reactor system in order to maintain drywell pressure within operating limits. Venting will also be required whenever the containment is inerted or de-inerted and, for the inerted containment, whenever the oxygen concentration approaches the 5.0 by volume design limit.

As discussed in Report No. 7 a Drywell Pneumatic Supply System is being installed to provide a clean gas source for pneumatic equipment. This system forms a closed loop with the drywell atmosphere, thus eliminating the leakage addition which would require venting during normal operation. A P&ID of the system is attached to Report No. 7.

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REPORT NO. 3

INVESTIGATION OF FAILURES

OF

RADIOACTIVE LIQUID WASTE SYSTEM

March 17, 1971

Commonwealth Edison Company

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REPORT NO. 3

COMMENTS

Provide detailed results of your investigation of the failures of the radioactive liquid waste system. Provide description of any equipment modifications that you have made or plan to make.

RESPONSE

The system description, process diagram and piping and instrument diagrams are described in the FSAR. The principal bases for design and operation of the system include the following:

1. The system is a batch system.

2. All wastes are sampled as batches to insure they meet established criteria and requirements prior to discharge from the system, either for reuse in the station as condensate or for discharge to the discharge canal.

3. Waste discharges to the discharge canal must be at a rate such that the unidentified isotope mixture concentration in the canal does not exceed 10^{-7} μc/cc including background.*

4. The system was designed to handle one unit in operation and the other unit in start-up.**

5. Maximum design bases include the additional wastes expected from start-up, maintenance activities, unusual circumstances, (e.g., condenser tube leaks), and radioactivity content due to design basis fuel leaks. Near full time operation may be expected during such high volume periods.

6. Expected volumes and radioactivity contents are defined for "normal" station operation, i.e., extended operation at power. Under these conditions the system only operates a fraction of the day.

7. Table 1, extracted from design and process diagram data, shows the "normal" and maximum expected (design) throughputs for both D-2 operation alone and D-2 and D-3 operation. During a start-up period and until the station is shaken-down volumetric throughputs are expected to be above normal and may approach maximum

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* A State of Illinois requirement starting with the Dresden 1 Permit.

** Start-up is defined as initial and any subsequent startups such as after refueling.

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values. Performance of systems which produce radioactive wastes or which affect the discharge capability of radioactive wastes are also reflected in waste system performance. Correction of such problems generally requires correction at the source.

8. System design anticipated that operation of the radwaste system would be planned on a regular basis, especially the planning of transfers to insure against overflows and system overloading. It also anticipated appropriate station surveillance and maintenance activities to determine and correct abnormal radwaste inputs.

Experience During D-2 Start-up

Several times during the start-up and operation of D-2, the radwaste system has been full indicating limitations on its water processing capability. Table II shows system throughputs for various periods of time. Table III shows averages and ranges of such data for more direct comparison with the design bases of Table I. Column 3 of Table III shows reduced throughput volumes for a period in November 1970 after certain process changes and operating procedures had been made. Changes to the process are still in progress so final improvement in system capability is yet to be determined.

The following discusses the principal factors contributing to limitations on radwaste processing capability and the corrections made or being made. Other changes have also been instituted to improve component maintainability, to correct deficiencies found during start-up, and to reduce operating manpower requirements.

Principal factors are:

1. Short filter runs, especially with the floor drain filter. In some cases, the filter run length was so short that the amount of waste water generated during backwashing approximated the amount processed through the filter. Thus, little progress could be made in accommodating the continuing input.

2. Cross-contamination of radioactivity and conductivity (soluble impurities) between the high purity (waste collector) and floor drain subsystems. The radioactivity of the floor drain wastes were thus higher than expected. This resulted in low rates of flow of the floor drain wastes to the discharge canal.

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REPORT NO. 3

3. Inability to produce adequate quality water in the waste collector sub-system. This had several negative effects on the system.

   a. Total station (D-2) make-up water requirements were exceeded by routing heating steam condensate from waste concentrator operation to the waste collector sub-system. This additional water input had the effect of introducing new make-up water into the station so if it, plus normal treated wastes from the waste collector sub-system, were returned to condensate storage, then condensate storage would overflow. To keep this from occurring required added waste discharge to the canal. This also added to restricted overall radwaste processing capacity, i.e., more water required discharge than capacity was available for.

   b. The failure of the waste concentrator due to acid attack could have affected station operation adversely. However, the practice of backwashing the condensate demineralizers rather than regenerating each time to relieve pressure drop removed a "normal" design input to the waste concentrator so its operation was not necessary. Actually, removal of this equipment from service was useful in assisting in the recognition of some of the above problems.

4. A substantial condenser tube leak occurred which again created a need to discharge more water to the canal. This water had sufficiently low activity to permit rapid discharge but it did put an abnormal load on the waste system.

5. Poor waste demineralizer performance and inadequate use of the waste demineralizer created off-standard wastes in the waste sample tanks. High conductivity of wastes in the waste sample tanks precluded their return to condensate storage. Thus, they were discharged to the discharge canal or were recycled to the waste collector and/or waste surge tanks for reprocessing. Discharge to the canal at low rates (within license limits) held up processing of other wastes (floor drains). Reprocessing caused increased use of process equipment. Both caused reduction in overall radwaste throughput capacity.

   Since waste sample tank water is also used to backwash radwaste filters, the poor quality (in this case higher than expected radioactivity) added to the radioactivity of the floor drains.

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REPORT NO. 3

Radwaste System Modifications

Modifications to the system and its operation were accomplished or are being accomplished as follows:

1. Short filter runs were due primarily to high insoluble material (crud) inputs of hundreds of parts per million. The body feed system on the filters adds filter aid to the filter feed to keep the filter cake porous. This system was enlarged to provide sufficient body feed to accommodate the high crud loads experienced. Pipe plugging problems were also overcome by improved line flushing procedures. Use of this system improved filter run lengths.

   To further improve filter operation steps were taken to reduce the crud input to the filters:

   a. A suitable flocculating agent was developed and equipment provided for its use. This process permits the fine crud in the collector tank to settle to the bottom where it is drawn off to the waste sludge tank. This procedure plus proper body feeding has improved filter run lengths so they are now at about the design value even with the high crud concentrations present. The system will thus be able to process the wastes from D-3 startup which are also expected to have high crud concentrations.

   b. High crud input to the floor drain collector tank also occurred due to the return of centrifuge liquid effluent. This is now being returned to the waste sludge tank (a principal source of centrifuge feed) to eliminate this significant crud load on the floor drain filter.

      Steam piping and a procedure has been installed to permit in-place cleaning of waste and fuel pool filters. Periodic plugging of the filter elements caused initial high pressure drop across the filter and consequent short filter runs. Waste filters are routinely cleaned weekly. Prior to making the above modifications filter runs were about 2000 gallons. Runs of 18000 to 20000 gallons with a pressure drop of <20 psi (30 psi is the operational limit) have been obtained. The longer filter runs have reduced the volume of water requiring processing and the volume of sludge in solid radwaste since fewer backwashes and fewer precoats are required. See Table III for improved volumetric throughputs. The revised system has handled input crud loads of 10 to 50 times the normal design load.

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REPORT NO. 3

2. Drywell floor drains are to be routed to the waste collector subsystem eliminating this possible activity source from the floor drain subsystem. One source of conductivity entering the waste collector subsystem ceased when the failed waste concentrator was removed from service.

   Sample sink drains are being segregated to minimize activity input to the floor drain subsystem.

   Curbs are being placed around certain equipment drain sumps to prevent activity and high conductivity from entering these sumps in the event of floor drain sump overflow.

   Entry of off-gas drains into the radwaste floor drains has been eliminated as a source of high activity in floor drains. Spent resin tank has a pump to remove excess water and thus prevent overflow to the radwaste floor drain sump and consequent entry of radioactivity.

3. Other piping changes which are in progress to complete the segregation of wastes by radioactivity and conductivity are:

   a. One of the two clean-up surge tanks is to be used to receive backwashes from the waste filter and fuel pool filters.

   b. Centrifuge liquid effluent routings are being added to return this effluent to the clean-up surge tanks when centrifuges are processing waste slurry from this source.

   c. Centrifuge liquid effluent can also be returned to the waste collector tank when spent resins are being centrifuged.

   d. Clean-up sludge tank decant piping is being installed to permit decanting to the waste collector tank.

   As the result of these changes, floor drain sludges will go to the waste sludge tank. The waste sludge tank will serve as a centrifuge feed tank and during such operation centrifuge liquid effluent will recycle to this tank. Excess water in the waste sludge tank will return to the floor drain collector tank for processing.

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Similarly, waste filter, fuel pool and reactor clean-up system sludges will go to a clean-up waste tank. When these sludges are centrifuged, the liquid effluent will return to a clean-up waste tank. Excess water from clean-up sludge tankages will be decanted to the waste collector tank for processing.

When spent resins are centrifuged, liquid effluent will return to the waste collector for processing.

By these modifications intermixing of radioactivity and conductivity between waste collector and floor drain systems will be virtually eliminated, and activity in canal discharges reduced accordingly.

4. Use of thoroughly regenerated resins in the waste demineralizer resulted in the production of high quality water which can be returned to condensate storage. This has reduced the amount of waste discharged to the canal and the design condition of returning this treated water to condensate storage now exists. Operation of the conductivity cell in this subsystem is now proper so proper control of these wastes is attained.

   The presence of high quality water in the waste sample tanks, compared with previous low quality water has also reduced activity input into the floor drain subsystem. Water from the waste sample tanks is used for filter backwashing.

   Reduced activity concentrations coupled with full use of condenser circulating water pumps have improved the capability for discharging wastes to the canal and reduced this previous bottleneck.

5. The failed waste concentrator has been replaced with an improved design concentrator. The new unit has been installed and tested and is operational. This will provide additional concentrator availability.

   In addition an ultrasonic resin cleaner is being installed at the Unit 3 condensate demineralizer regeneration system. It is being piped to permit use on Unit 2. The ultrasonic resin cleaner is a device, tested at Dresden 1 for the past year, for cleaning the ion exchange resins in the deep bed condensate treating system. The accumulated crud (principally iron oxides) is removed as a thin water slurry to the waste collector sub-system of radwaste. The need for use of regeneration chemicals to remove the crud from the resins is thus reduced to the need for regeneration of ion exchange capacity. Since ion exchange capacity is principally used when and if condenser tube leaks occur, the use of regenerant chemicals and the resulting liquid waste is substantially reduced. A potential waste stream to the discharge canal is thus substantially minimized. Potential solid waste quantities (concentrated waste) are also reduced.

The original concentrator failed due to acid attack. Laboratory tests of 304 L coupons welded with 308 rod and of 316 L coupons welded with 316 rod indicated insignificant attack in pH 3 and 5 sulfuric acid solutions at boiling temperature and mirror attack in pH 1 acid. To date, only tests in 10-20 percent boiling acid have indicated attack similar to that which occurred in the failed unit. Attack was predominant in the 308 weld material, as in the concentrator. Type 316 L material and rod showed better resistance than type 304 L plate and 308 rod. The replacement unit is of 316 L stainless steel. Failure of the original unit is attributed to the presence of sulfuric acid.

Steps to safeguard against possible future failure include:

a. Provision of an improved resin trap in the waste line from the condensate demineralizer regeneration system. This will minimize resin entry into the waste neutralizer tanks which feed the waste concentrator.

b. Strengthened procedure/administrative control to insure neutralized waste tank contents are indeed neutralized prior to feeding the concentrator.

Concurrently, the heating steam boiler will be isolated from potential radioactive solution leaks from the waste concentrator. Failure of the waste concentrator resulted in contamination of the heating boiler water. An intermediate steam generator is to be installed to provide a secondary steam source for the waste concentrator and other steam heated equipment containing radioactive solutions, e.g., the concentrated waste tank.

Pending the procurement and installation of this steam generator, means are installed and procedures established to permit periodic pressure testing of the waste concentrator steam chest and to insure that steam chest pressure is always greater than the pressure in the concentrator. Such a pressure differential normally exists during concentrator operation. An air pressuring system has been added to maintain such a differential during transfer of concentrate and shutdown. This system will also permit air pressure testing prior to each concentrator re-start.

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D-2

REPORT NO. 3

Items to Improve System Maintainability, Operability and Performance

Efforts in this category include the following:

1. Cross-connection of floor drain and waste collector pumps is installed to provide alternate routings in event of pump failure. A complete spare pump is also available for replacement.

2. Additional block valves to maximize processing capacity of radwaste subsystems and/or components during maintenance of air operated valves are partially installed.

3. Added instrumentation to waste concentrator to prevent maloperation and overflow is being installed.

4. Investigation is being made of radwaste sources to determine if reductions are possible.

Radwaste Planning

1. A daily planning of radwaste operations has been instituted, whereby the operators are given instructions as to the various waste water movements to be made. Such planning can anticipate inputs such as from condensate demineralizer backwashing and regeneration, resin transfers from the clean-up system, draining and flushing of equipment for maintenance, etc. The net result of such planning is to keep the wastes moving through the system, recognize and correct difficulties as may occur and keep tank inventories low. Proper planning and execution thereof, thus leaves capability and capacity available for emergency conditions, e.g., unexpected release from relief valves, condenser tube leaks, etc.

2. In addition to planning of the operation, daily log sheets provide data on waste volumes processed through the various subsystems. Charting of such data can show trends in station performance. Thus, a systematic increase in floor drains would lead to a search for the cause of the increase and plans for corrective maintenance. Waste volumes would thus be kept in the "normal" design range so system capacity wouldn't be impaired by continued abnormal inputs.

D-2

REPORT NO. 3

Summary

The difficulties encountered during D-2 start-up have been substantially diminished and corrected by the modifications enumerated. Some of the modifications have been implemented on a temporary basis pending procurement and installation of permanent equipment. Incorporated in the permanent modifications are controls on the radwaste panel to relieve the operator of multi-location operations and centralize his control operation.

Modifications are continuing within the time limitations of equipment supply and maintaining station operation. Meanwhile, D-3 is starting to produce radwastes which are being handled successfully.

TABLE 1

	DESIGN BASIS	
	D-2 (ALONE)	D-2,3
WASTE COLLECTOR		
Norm, gal/day	24,000	48,000
Max, gal/day	100,000	188,000
	AT 20PPM SOLIDS	AT 20PPM SOLIDS
FLOOR DRAIN COLLECTOR SYSTEM		
Norm, gal/day	11,000	20,400
Max, gal/day	44,000	96,000
	AT 20PPM SOLIDS	AT 20PPM
	MAX 6 LBS/DAY	NOT MEASURED
WASTE NEUTRALIZER SYSTEM		
Norm, gal/day	11,000	21,000
Max, gal/day	21,000	21,000
	AT 20PPM	AT 20PPM

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TABLE II

RADWASTE WATER VOLUMES DURING 70 DAYS OF START-UP

DATE	FLOOR DRAIN gpd	FLOOR DRAIN mci	WASTE COLLECTOR gpd	WASTE COLLECTOR mci	WASTE NEUTRALIZER gpd	WASTE NEUTRALIZER µci/cc	MAXIMUM POWER (%)
3/29	13,200	.03					Critical
3/30	43,000	.04					0
3/31	34,400	.11	88,700	1.55	29,000		0
4/1	37,800	.79	16,500	.20			0
4/2	50,800	.37	23,760	.59	25,500		0
4/3	34,760	.11	11,900	.03			0
4/4	53,580	.48	50,500	.86	14,900		Critical
4/5	35,200	.09	18,200	.01	13,600		Critical
4/6	53,480	.52					Critical
4/7							0
4/8	50,800	1.10					Critical
4/9	52,800	1.37	51,500	.95	28,200		Critical
4/10	52,800	9.19	24,100	.75	8,300		Critical
4/11	17,600	.03	62,700	.77			Critical
4/12	50,100	1.00	50,700	.80	14,700		Critical
4/13	31,240	.18	-		15,700		Critical
4/14	56,320	1.76	45,900	1.11			Critical
4/15	15,600	1.24	29,000	.05			7
4/16	19,600	.35	30,400	.32			10
4/17	33,300	61.87	*43,000		12,200		10
4/18	18,300	21.4			14,000		0
4/19	52,320	.75			14,000		0
4/20	27,300	.27			14,600		2
4/21	31,800	25.13	12,500	1.80	25,400		25
4/22	29,000	.52	*23,000				25
4/23	52,800	12.96	*27,000		9,600		25
4/24	31,240	11.61	26,400	1.60	6,100		31
			*86,000				
4/25	18,000	4.23	*26,000		15,400		40
4/26	53,000	29.06	*26,000				50
4/27	52,600	45.10	*25,000		29,800		50
4/28	34,800	20.55	*51,000		12,800		50
4/29	20,000	1.58	38,600	2.33			50
			*23,000	Bkg			
4/30	36,300	37,89	23,760	.55			
			*24,400	Bkg	13,100		50

TABLE II
(Continued)

RADWASTE WATER VOLUMES DURING 70 DAYS OF START-UP

DATE	FLOOR DRAIN gpd	FLOOR DRAIN mci	WASTE COLLECTOR gpd	WASTE COLLECTOR mci	WASTE NEUTRALIZER gpd	WASTE NEUTRALIZER μci/cc	MAXIMUM POWER (%)
5/1	70,000	62.69	27,000	.80	28,500		52
5/2	83,000	164.58	29,600	2.24			
			*27,000	1.1×10^{-5} mci/ml			
5/3	38,100	51.70	*54,000	2×10^{-5}			38
5/4	17,600	12.46			14,600		38
5/5	39,600	26.88	*58,400	3.3×10^{-5}	13,000		40
5/6	16,500	9.99	*28,000	4×10^{-5}			25
5/7	49,100	26.1	*26,000	2.2×10^{-5}			50
5/8	73,400	17.27	*28,000	3.6×10^{-5}	13,400	5.9×10^{-4}	10
5/9	33,700	16.18					0
5/10	55,60	45.35	*25,000	$.98\times10^{-5}$	12,600		0
5/11	33,000	39.55	*28,000				8
5/12	36,100	27.16			13,000		35
5/13	15,600	7.68	*25,000	3.1×10^{-5}			70
5/14	37,600	67.00	*25,000	$.8\times10^{-5}$	8,000	1.96×10^{-4}	75
5/15	15,600	7.68					75
5/16	39,200	86.09	*29,400	6.3×10^{-4}			3
5/17	14,100	46.36			*13,000	1.9×10^{-3}	50
5/18	34,300	29.01	*27,000	3.3×10^{-5}			75
			*25,400	$.4\times10^{-5}$			75
5/19	9,680	12.82	*26,700	-			
			*22,800	1.1×10^{-4}			
5/20	16,280	33.27					75
5/21	11,400	16.45	*23,800	6×10^{-5}			60
5/22	12,760	25.60			13,000	1.4×10^{-3}	67
5/23	9,700	65.94	*49,000	9×10^{-5}			50
5/24	35,420	178.53	*74,300	3.3×10^{-5}	27,000		55
5/25	16,900	70.53	*28,100	5.4×10^{-6}			55
5/26	53,000	152.14	*19,800	5.9×10^{-5}	12,800	7.3×10^{-3}	55
5/27	30,400	51.83					75
5/28	4,620	17.49	*24,800	2.1×10^{-5}			75
5/29	14,960	44.73					75
5/30	11,880	143.89			12,899	6.9×10^{-3}	50
							50
			*26,400	5.9×10^{-5}			15

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TABLE II

RADWASTE WATER VOLUMES DURING 70 DAYS OF START-UP

DATE	FLOOR DRAIN		WASTE COLLECTOR		WASTE NEUTRALIZER		MAXIMUM POWER (%)
	gpd	mci	gpd	mci	gpd	µci/cc	
6/1	14,740	81.45					75
6/2	18,260	63.31			12,800	1.4×10^{-3}	75
6/3	19,800	116.16	*25,100				75
6/4	28,200	56.67	26,400	3.7	8,300	1.1×10^{-3}	75
			*26,700	2.9×10^{-5}			75
6/5	41,800	95.0	24,400	2.59			100
6/6	27,000	13.67	54,500	4.66	15,360	$.45 \times 10^{-3}$	0
			*72,600	3×10^{-4}			
Average	32,000	37**	28,000	$\sim 3 \times 10^{-5}$	8,800	2×10^{-3}	
Design							
Norm.	46,400	40	*30,000	3×10^{-5}	21,000	2×10^{-3}	
Max.	117,000	600	*188,000	6×10^{-4}	-	5×10^{-1}	

* Water recycled in plant, activity in µci/cc.
** Averaged over highest 7 days.

Note: 4/1 828,000 gallons of water from Hotwell was discharged.
4/2 435,000 gallons of water from the Torus was discharged.

TABLE III

	DESIGN BASIS	OPERATING DATA (3/29/70-6/6/70) (From Table II)	NEW DATA (10/24/70-1/18/70)
WASTE COLLECTOR SYSTEM VOLUME	AVG. - 24,000 GAL/DAY	AVG. 28,000 GAL/DAY*	16,000 GAL/DAY
WASTE COLLECTOR FILTER RUN LENGTH	30,000 GAL/RUN @ 20 PPM	10,000 GAL/RUN	18,000 GAL/RUN
FLOOR DRAIN SYSTEM VOLUME	AVG. 11,000 GAL/DAY	AVG. 21,000 GAL/DAY	11,700 GAL/DAY - INPUT** 8,800 GAL/DAY - INTERNAL
FLOOR DRAIN FILTER RUN LENGTH	30,000 GAL/RUN @ 20 PPM	2,600 GAL/RUN @ 200 PPM	6,000 GAL/RUN @ 300 - 700 PPM

* Table II, Floor Drain data actually includes waste neutralizer wastes. Thus, floor drain wastes count neutralizer wastes twice; 28,000 gpd is average for floor drain wastes only.

** 11,700 gpd still reflects station heating condensate return leakage which is being corrected.
8,800 gpd represents resin transfer water and sludge tank decant.
Floor drains during the period November 8-19, 1970 averaged 14,000 gpd total, representing operation with flocculation and body feed which did not consistently occur during December and January.

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REPORT NO. 4

INSTALLATION OF RADIOACTIVE OFFGAS SYSTEM

March 17, 1971

Commonwealth Edison Company

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D-2

REPORT NO. 4

COMMENT

Your schedule for the design, installation, and operation of emission-reducing equipment for the radioactive offgas system.

RESPONSE

As required by the Dresden 3 technical specification, a schedule and design will be submitted by June 1, 1971.

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REPORT NO. 5

EVALUATION OF FAILED FUEL

DRESDEN UNIT 2

March 17, 1971

Commonwealth Edison Company

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D-2

REPORT NO. 5

COMMENTS

The results of your evaluation of the causes of the failed fuel in Dresden Unit 2.

RESPONSE

This report will be submitted after final evaluations are made from the Dresden 2 refueling that is now in progress.

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REPORT NO. 6

REACTOR ASYMMETRICAL NEUTRON FLUX DISTRIBUTION

March 17, 1971

Commonwealth Edison Company

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REPORT NO. 6

COMMENT

A detailed description of the causes and corrective actions for the reactor asymmetrical neutron flux distribution.

RESPONSE

Background

During plant startup of Dresden-2, indications of a power asymmetry problem were identified. These indications were the results of differences between the TIP and LPRM readings which were taken during the startup testing. The indicated asymmetry was as high as a ratio of 1.16 when comparing the power level at two symmetric locations in the core.

Previous Experience

During early operation of the KRB core a similar problem was thought to have occurred and testing was performed on that core. The asymmetry at KRB existed between certain pairs of monitored locations. During a shutdown a gamma scan was performed on the fuel to check if such asymmetry actually existed. The gamma scan showed that there was no real power asymmetry and further testing was then performed to determine the cause of the indicated asymmetry. The most obvious source of the indications would be the location of the LPRM assembly in the water gap and the variation of the location of the internals within an LPRM assembly. An analysis method was developed in which the TIP traces were digitized and the value of the integral from the digitization was studies. Using this data it indicated that for a given TIP location, this integral repeated itself with an accuracy of approximately one percent. A statistical study of a ratio of these integrals for a given pair of locations in the core was performed for a number of cores. This statistical study showed that for the symmetrical locations in the core, a ratio of the integers yielded a value of 1.00 with a sigma of about 0.03. This meant that the indicated asymmetry between the power levels at two symmetric locations in the core could be as high as a ratio of 1.07 and in general, the values would be between 0.97 and 1.03. This statistical evaluation measured the variations in power asymmetry which could be caused by mechanical or geometrical variations. Possible mechanical or geometrical variations are movement of the LPRM tube out of the center of the watergap into the space between two fuel bundles or up against the corner of one of the fuel bundles. Other variations also include the twisting or displacement within the tube of the various detectors such that the relative location in a tube would differ between two

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symmetrical locations in the core. The effect of bowing of a LPRM tube was also covered by this statistical evaluation. For KRB the maximum indicated asymmetry was 1.07 and was determined to result from mechanical or geometrical variations. Measurement on Dresden-2 showed the ratio of the integrals to be as high as 1.16 which is well beyond the statistically predicted limits for the effect of LPRM location, thus additional study of the Dresden situation was needed.

Dresden Investigation

The Dresden investigation was broken down into parts to attempt to differentiate between the various effects which could possibly cause this condition and to attempt to eliminate, as much as possible, those which were not causing the problem.

Physical Location of TIP

A movement of the assembly from the design center to a corner location increased the TIP indication. This increase resulted regardless of the direction in which the TIP assembly was moved, and due to the interplay of all variables associated with the flux in the watergap. This clearly showed that bowing or movement of an LPRM assembly will result in higher readings for one symmetric location as compared to its partner.

LPRM Assembly Variations

During the July, 1970 shutdown of the Dresden-2 plant, testing was accomplished to provide additional information on the asymmetry of the flux distribution. Operation of the plant prior to the shutdown indicated that some LPRM assemblies had low sensitivity and were not providing reliable information. Within the time limitations available during the shutdown period, some LPRM assemblies were replaced. Selection of the locations in which to replace LPRM's was done to maximize the information to be gained about the power asymmetry indications. Maximum information was gained by comparing power measurements between an old and a new LPRM assembly and by selecting LPRM locations in which the integral ratio was very high. Figure 1 shows the locations in which LPRM's were replaced. In one case one of the LPRM assemblies, of a pair which had a very high ratio, was replaced and the adjacent high ratio pair was not disturbed. In other locations, both LPRM assemblies of a given pair were replaced. Examination of the TIP ratios, after the reactor was restarted, confirmed that indications of asymmetry in the Dresden-2 core was in part due to mechanical and geometrical variations. In the most severe location the ratio between symmetrical pairs dropped from 1.16 to 1.09.

Gamma Scan

During the shutdown a gamma scan was also performed. This gamma scan indicated that the power asymmetry was approximately 7% and it confirmed that the asymmetry was in the same direction and magnitude as indicated by the TIP data. The gamma scan was performed with an ionization chamber assembled in a system which had the capability of determining power with an accuracy of 3%, i.e., 1.07 ± 0.03.

Reactivity Variations

To determine if any of the asymmetry could be attributed to the fuel, control curtains, or control rods, a set of critical assembly experiments were performed in each region of the core where the larger asymmetry conditions were indicated. The results showed that the effects from fuel, control curtains, or control rods were in the same order of magnitude as observed on other plants and were of such a small magnitude that they could not be a major cause of the power asymmetry.

Flow Variations

The possibility of flow non-uniformity being a cause of the power asymmetry was evaluated. An evaluation of the flow in the plenum determined that to produce the indicated asymmetry, local pressure variations of 7 to 9 psi would have to exist. Because this amount of pressure drop is 20 to 30 times greater than the total expected plenum loss this was eliminated as the cause of the power asymmetry. Flow variations between fuel bundles were investigated. The problem of flow variations between bundles is evaluated very thoroughly in core design and was determined not to be the cause of the asymmetry. In addition, a detailed flow evaluation was performed at the Monticello plant which is applicable to Dresden-2. The results of the evaluation showed that no significant flow maldistribution occurred and reaffirmed that flow distribution was not the cause of the asymmetry.

Enthalpy Variations

Having eliminated all the more obvious causes of the asymmetry problem, an investigation was conducted to determine if core inlet enthalpy non-uniformity could cause the indicated power asymmetry. The first step in this evaluation was to operate the reactor at 75% power and full flow and 35% power with natural circulation flow with the same control rod pattern. The TIP information determined from these two evaluations showed that a pattern for asymmetry existed which could be correlated with a feasible non-uniformity in core inlet enthalpy.

To further identify this situation, a test was performed in which the feed water inlet temperature was varied from 320° to 220° while the core was operating at 75% power and 100% flow. If the power asymmetry was induced by non-uniform core inlet enthalpy, this test would cause an increase in the asymmetry. The results of the test showed that the inlet enthalpy variation resulted in a measurable increase in the asymmetry hence was major cause of the power asymmetry. Although the relationship is not quite linear, the increase of power asymmetry corresponded to that which would be expected for a 50% increase in the non-uniformity of inlet enthalpy.

CONCLUSIONS

The preceding paragraphs have presented an evaluation that has been conducted on the power asymmetry indications. The program has eliminated several of the possible causes of such asymmetry and has narrowed the cause to non-uniformity of inlet enthalpy. However, this cause has not been positively identified particularly in the area of exact magnitude. Further investigation of this phenomenon is continuing.

Dresden-2 is operated such that individual power and MCHFR calculations are performed to determine that the core is operating satisfactorily. Reactor power and linear heat flux are determined directly from instrumentation, therefore, already accounts for variations in power induced by the existence of non-uniform core inlet enthalpy. The determination of MCHR is affected but in the conservative direction, i.e., calculated MCHFR will always be less than actual MCHFR. The MCHFR for the core is located in a high power bundle, however, MCHFR is calculated by assuming uniform core inlet enthalpy. If a bundle or region is supplied with coolant at an enthalpy lower than average inlet enthalpy, the power in that bundle or region will be greater than the average power. Because incore instrumentation indicates actual power and MCHFR is calculated using the average inlet enthalpy, and the MCHFR for the core is located in the high power assembly, MCHFR will always be calculated at a value less than actually exists. Operation of Dresden-2, in compliance with approved technical specifications using calculated MCHFR, always results in a conservative MCHFR and ensures adequate margins for all calculated transients and postulated accidents.

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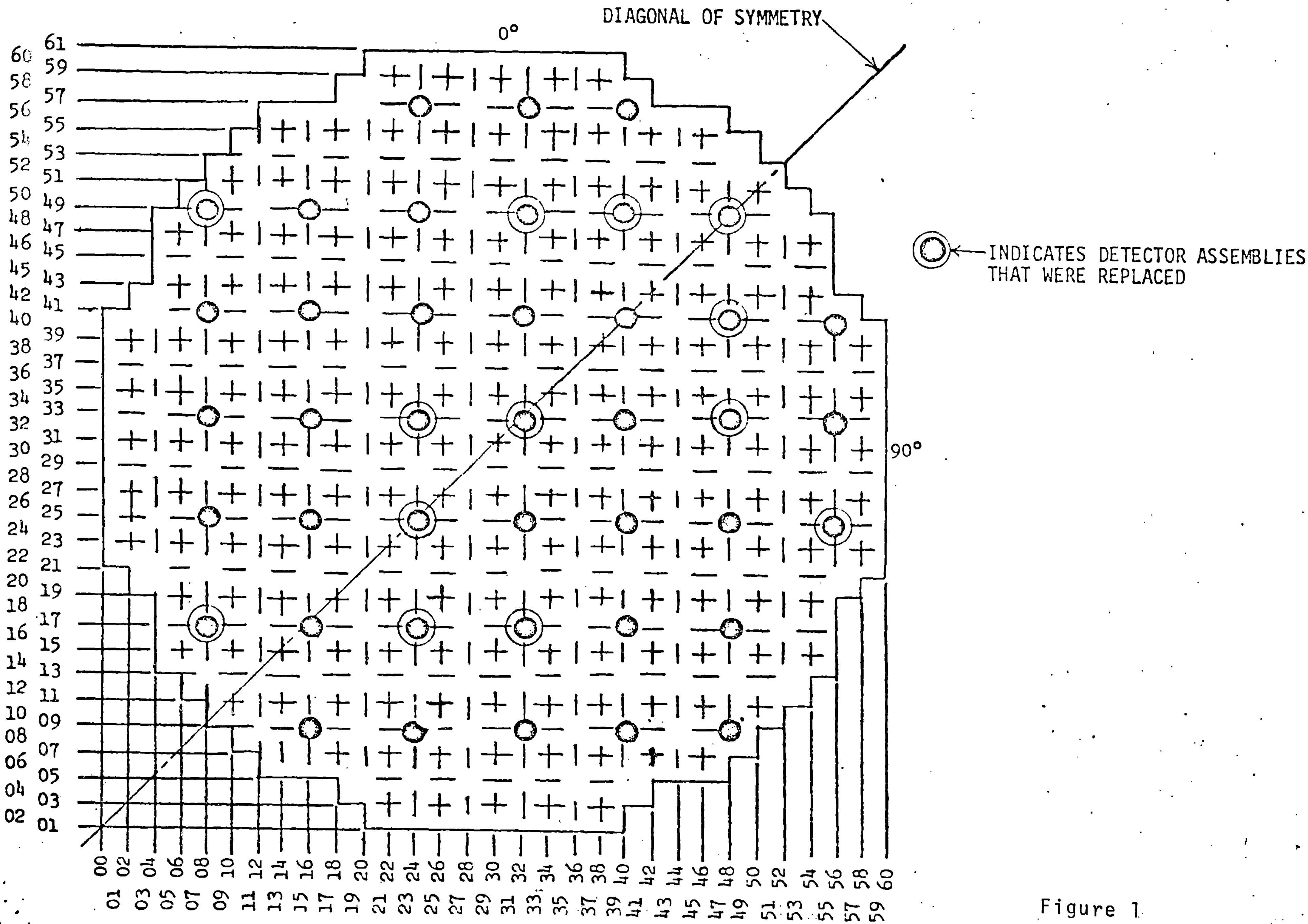

Figure 1

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REPORT NO. 7

CORRECTIVE ACTIONS TO ASSURE
MAIN STEAM LINE ISOLATION VALVE
OPERABILITY

March 17, 1971

Commonwealth Edison Company

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REPORT NO. 7

COMMENT

A detailed report of corrective actions taken to assure main steam line isolation valve operability.

RESPONSE

Background

On several occasions between April 30, 1970 and February 1, 1971 the main steam isolation valves (MSLIV's) installed in the Dresden 2 Nuclear Power Plant failed to operate due to sticking of the pneumatic valves which control the flow of air to a cylinder operator to open and close the MSLIV's.

The pneumatic valves in use during April and May 1970 had small clearances and were highly sensitive to contaminated air and excessive heat. Test thermocouples installed on the outside of the pneumatic valve housings showed that in operation the valves installed in the drywell reached approximately 129°F and valves in the steam tunnel reached 175°F. Inspection of the valves showed the lands of the spools were significantly discolored and coated with a varnish-like substance. All spools were very sticky in the sleeve. When the spools were washed in solvent and cleaned up, they freed up considerably, but not as free as manufacturer representatives recommended for a normal spool and sleeve. Therefore, it was concluded that two problems were being encountered. First, there was contamination getting into the valve in sufficient quantity to cause the spools and sleeves to stick and bind. In addition, some of the spools and sleeves were binding mechanically because of the heat. Either one of the two problems would render a valve of the type used at that time inoperative. As discussed in the Special Report on the June 5 incident, Supplementary Information, steps were taken to replace all the pneumatic valves with higher clearance type valves and also additional air conditioning equipment was added to the steam tunnel to reduce temperatures in the area of the valves.

In early December 1970 four main steam isolation valves failed to close and one closed out of tolerance during a schedule surveillance test. Upon inspection of the pilot valves the same sort of contamination on the spool caused the sticking. The source of the contamination has been traced to the air supply compressors. These are oil lubricated compressors. After a significant period of operation the oil leaks into the air supply.

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Corrective Action

The following corrective actions will be taken to eliminate the MSLIV actuation problems:

1. The clearance between the sleeve and spool has been increased and additional air cooling has been installed in the steam tunnel to eliminate binding caused by high temperature.

2. The instrument air system for both Dresden 2 and 3 has been thoroughly cleaned to avoid entrainment of dirt and oil.

3. Three different plans of action are being undertaken to ensure oil and other contamination are not introduced back into the MSLIV pneumatic supply.

   a. The valves inside the drywell will take their supply from a pumpback system. This system consists of two air compressors, filters, separator and dryer, a 250 gallon receiver, and associated piping, valves, controls and instrumentation. The drywell pneumatic supply system takes suction from the drywell atmosphere, compresses and cleans the gas and stores it in the 250 gallon receiver at a nominal 100 psig. The receiver discharges to the equipment in the drywell which require motive gas. This system provides a source of clean gas for use in all pneumatic equipment thus limiting the effects of dirt and oil on the operation of MSLIV's. This system is being installed during the current outage. The system will be connected to the presently installed pneumatic system to supply all the equipment within the drywell requiring motive gas. The back up supply is nitrogen from the Drywell Atmosphere Make-Up System. A copy of the P&ID for the Drywell Pneumatic Supply System is attached.

   b. As an interim solution the MSLIV valves located inside the steam tunnel will take their motive supply from four liquid nitrogen storage tanks. The liquid nitrogen system provides a constant regulated pressure of 115 psig to the supply system. The system is capable of continuous delivery of 800 scfh or 1850 scfh for short periods at pressures up to 150 psig. Each station comprises of: 1) filter, 2) a fin air vaporizer, 3) console with controls, 4) appropriate valves and pressure regulator, 5) liquid nitrogen tanks each having 3650 scfh capacity, and 6) pressure switch and low pressure annunciator in the control room.

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This system will be replaced by an oil-free non-lubricated compressor. The instrument air will be separated from the service air compressors and two non-lubricated compressors, redundant filters, dryers, air receivers, installed into the instrument air supply to form a completely separated oil-free system. The Dresden 2 and 3 instrument air supplies will be identical and "cross-tied" to provide redundant systems for both plants (each system has the capacity to supply both units). As the source of oil was being introduced into the system by the oil lubricated compressor, the installation of the new compressors will eliminate the source of contamination.

It is concluded that the corrective action described above will eliminate any further MSLIV problems. This conclusion is substantiated by the number of BWR's in operation with this type of valve without any actuator problems. The only difference between the successfully operating valves in these BWR's and Dresden is the air supply system.

After the completion of the corrective action described above, the plant will return to a normal technical specification surveillance program.

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Figure 1

GENERAL ELECTRIC

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TITLE P&ID

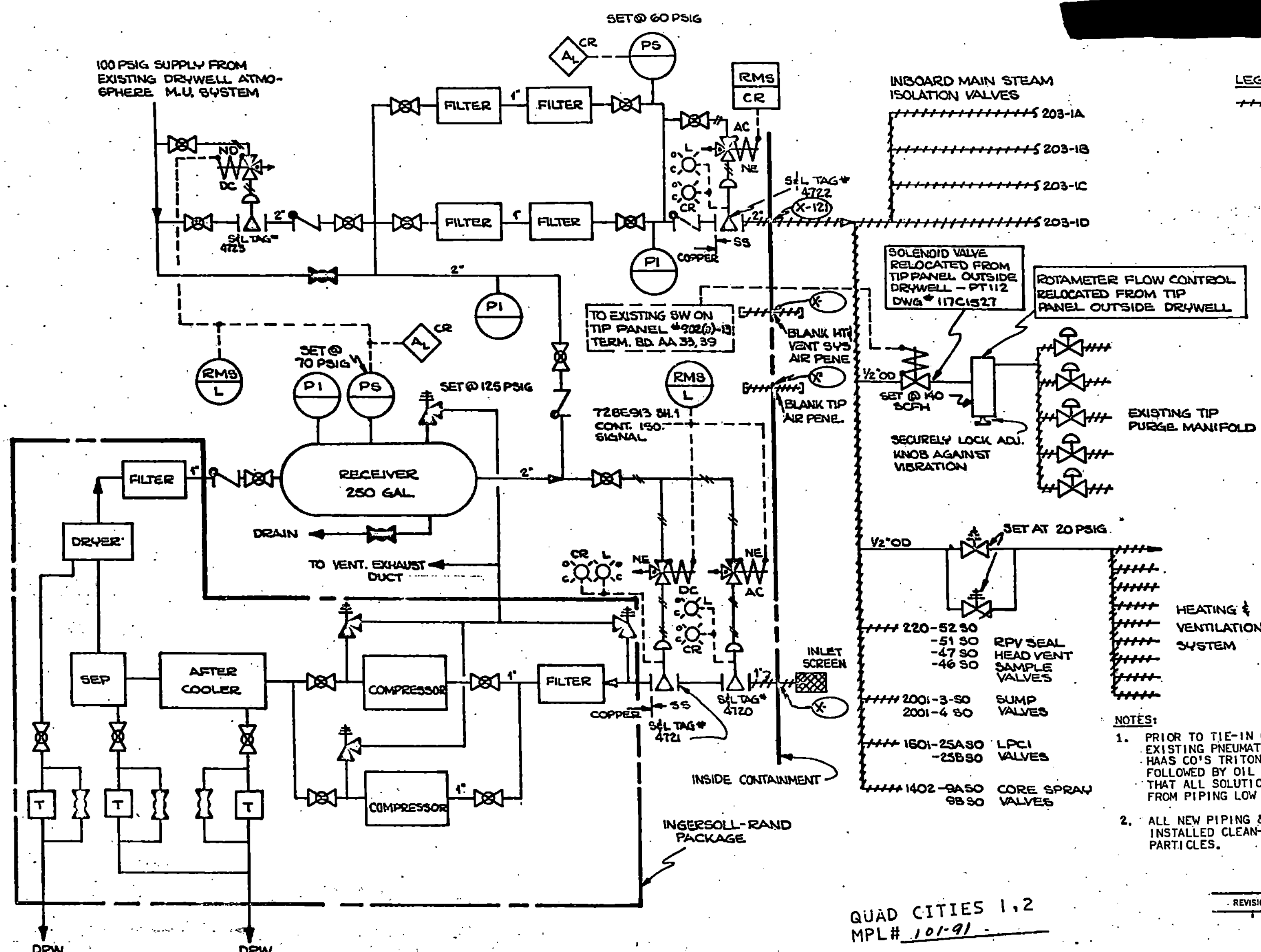
DRYWELL PNEUMATIC SUPPLY SYS

FIRST MADE FOR

UNLESS OTHERWISE SPECIFIED USE THE FOLLOWING:—

APPLIED PRACTICES	SURFACES	FRACTIONS	DECIMALS	ANGLES
	✓	±	±	±

[redacted]



NOTES:

1. PRIOR TO TIE-IN OF NEW PIPING CLEAN ALL EXISTING PNEUMATIC PIPING WITH RHOM & HAAS CO'S TRITON X-100 & DRAINING FOLLOWED BY OIL FREE DRY AIR BLOW. INSURE THAT ALL SOLUTION IS REMOVED--ESPECIALLY FROM PIPING LOW POINTS.
2. ALL NEW PIPING & COMPONENTS TO BE INSTALLED CLEAN--NO VISIBLE DIRT OR FOREIGN PARTICLES.

QUAD CITIES 1,2
MPL# 101-91

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REVISIONS | PRINTS TO

MADE BY P.P. Bailey 2-10-71 | APPROVALS | ISSUED Kidwell 2/21/71 | for 03F | APED | SAN JOSE, CALIF | 117C4641

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REPORT NO. 8

CORRECTIVE ACTIONS RELATED TO MALFUNCTIONS ON LPCI AND ISOLATION CONDENSER VALVES

March 17, 1971

Commonwealth Edison Company

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REPORT NO. 8

COMMENTS

Additional clarification of the corrective actions related to the malfunctions of the low pressure injection system and the isolation condenser valves.

RESPONSE

The following information is submitted to advise you of the present status and progress of inspection and maintenance program for insuring proper valve operability and correction of deficiencies related to the problems reported in our letter of January 15, 1971.

1. Special attention has been directed toward motor operated valve maintenance which included use of a new check list to record pertinent maintenance data for the purpose of defining the specific cause of any malfunction. This new check list requires periodic checking of the stem lubrication thereby visual inspection of the "locking nut staking". This check list supplements the cardex file record previously in use which is utilized to record repairs or adjustments made to motor operators.

2. A program has been initiated for lubrication of all valve stems. This has been completed for Unit 2 and 3 valves inside the drywell and Unit 2 valves outside the drywell. The program will continue similarly on Unit 3 valves outside the drywell and all turbine building valves until completed.

3. The stem drive nut locking nut threads have been re-staked on all valve operators inside Unit 3 drywell. Inspection is in progress on all valves outside the drywell in the reactor building for both Units 2 and 3 and re-staking is being performed wherever found to be inadequate. This will be continued on all turbine building valves and will be completed on Unit 2 drywell valves during the forthcoming refueling outage.

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D-2

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4. The torque settings are considered to provide adequate margin to insure proper valve operation presently on all valves.

5. A review of all breaker sizes revealed eight which are considered marginal. Five of these have been replaced with larger breakers and the other three will be replaced in the near future.

6. The manufacturer of the limitorque valve operators inspected 28 valve operators for Unit 3 at random on February 16, 1971 for lock nut adjustment and adequacy of staking. Several were found to have worked out of adjustment as a result of improper or inadequate staking. Therefore, the required corrections, as indicated in item 3 above, is currently being performed. The initial staking was performed either by the valve manufacturer or by the manufacturer of the limitorque valve operator as dictated by the valve manufacturer's purchase order.

We feel this program recognizes the valve operability problems and will correct the causes of the problems, thus minimizing or eliminating future problems.

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REPORT NO. 9

REPORT ON SEISMIC TEST PROGRAM

FOR

INSTRUMENT AND ELECTRICAL SYSTEM

DESCRIBED DRESDEN-2

FSAR, Amendment 16

March 17, 1971

Commonwealth Edison Company

REPORT NO. 9

Comment

The status of the seismic test program of certain components of instrumentation and electrical systems as described in Amendment 16 for Dresden Unit 2.

Response

The components of the instrumentation and electrical systems of the reactor protection system and engineered safety features of Dresden Unit No. 2 (D-2) are capable of withstanding the forces generated by the design basis earthquake (0.2g) and performing their required functions. The capability of these components was tested and the results of the tests were reported in Amendments 13, 16 and 17 on the Quad-Cities (QC) docket (AEC docket nos. 50-254, 50-265). A detailed review of the equipment in D-2 shows that the results of these tests are applicable to D-2. Plant revisions indicated by these results will be completed during the 1971 refueling outage.

QC Amendments 13 and 16 identified exceptions to the general acceptance criteria which had to be analyzed in more detail and compared to specific criteria. A review of these components for D-2 showed that the maximum "g" levels are less than that as shown in QC Amendment 16 (Q/A 7.1 (2) b). The results of this review are shown in the following table:

Instrument	Location (elevation-ft)		Floor Acceleration (max "g")	
	QC	D-2	QC	D-2
Reactor Level Switch	623	545.5	0.4	0.22
Scram Discharge Volume Level Switch	595	517	0.3	0.2
Condensate Storage Tank Level Switch	595	537.5	0.24	0.2
Main Steam Line Differential Press. Switch	595	497	0.3	0.13
HGA Relays	623	517.5	0.32	0.15

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Each component in D-2 which is comparable to the "exceptions" in QC Amendment 16 is shown to receive less "g" forces. It is therefore concluded that these components have a greater margin to failure than those which were shown to be acceptable on QC. In addition, because the "g" forces are less for D-2, there will be no inadvertent operation of the reactor level switch as occurs on QC.

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