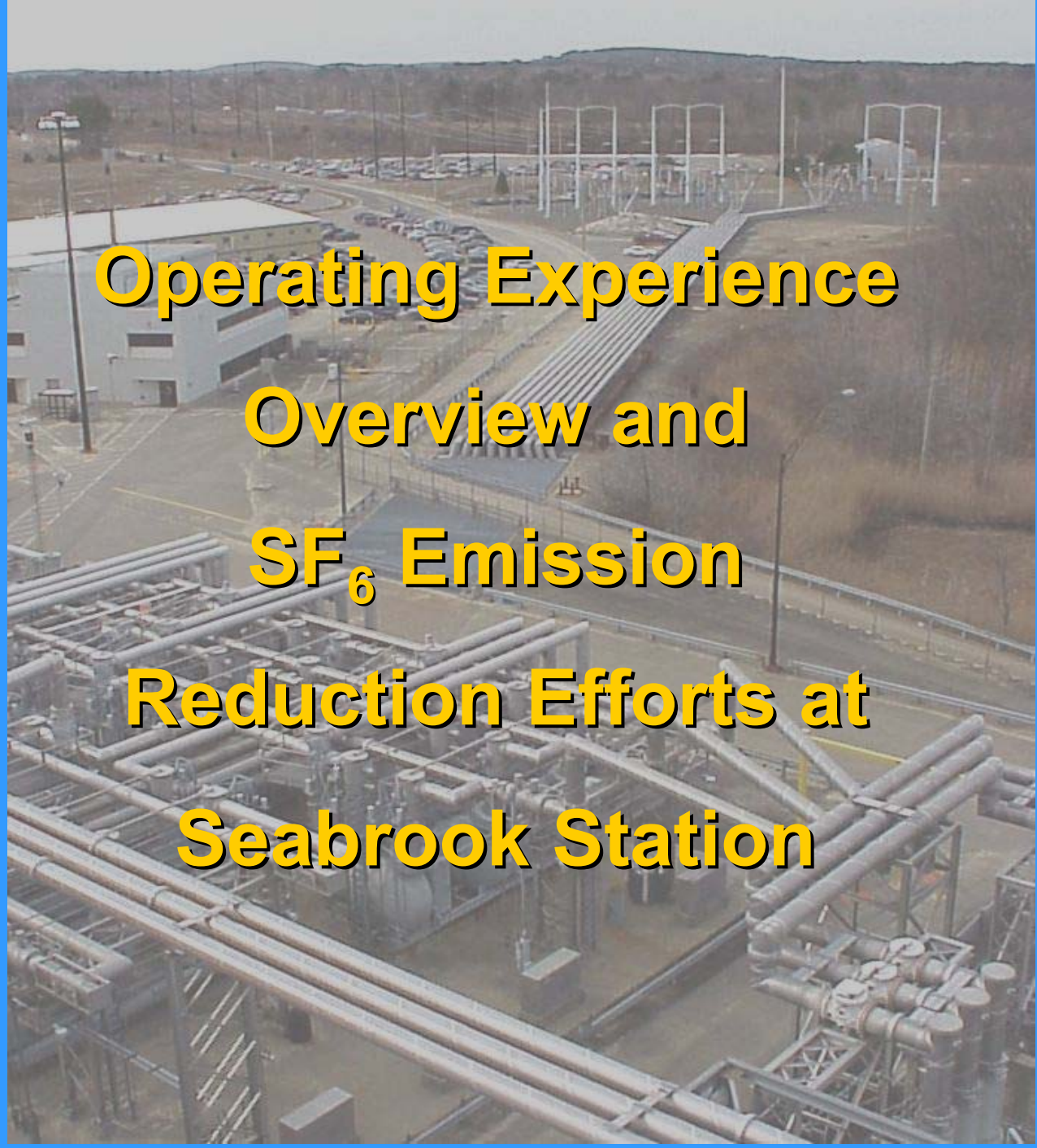

Operating Experience
Overview and
SF6 Emission
Reduction Efforts at
Seabrook Station

Seabrook Station
345-kV Distribution System

- 7 independent bus duct zones containing approximately 28,000 lbs. of SF_6 gas.
- 8 power circuit breakers containing 1,770 lbs. of SF_6 gas (14,160 lbs. total).
- Initially placed into service in 1982 to supply off-site power during construction of Seabrook Station.
- Commenced commercial operation in 1990.

345-kV Distribution System Design

SF_6 Bus Duct Design

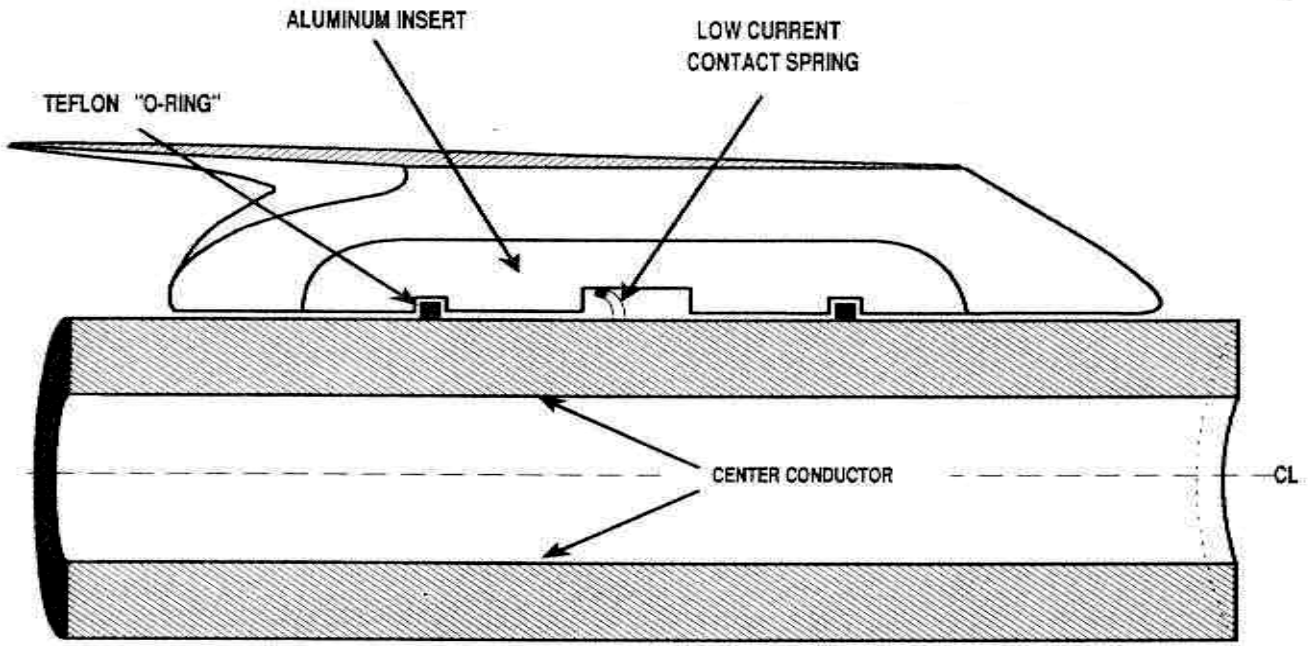
- Original ITE design bus duct included:
  - 6-inch hollow aluminum pipe for the conductor.
  - 18-inch outer aluminum enclosure.
  - Insulators composed of a cyclo-aliphatic epoxy with an alumina filler (1,037 total).
  - 9 porcelain air bushings at the transmission line interface.

SF_6 Power Circuit Breaker Design

- ITE design power circuit breakers:
  - The low pressure (LP) subsystem, 40 to 45 psig, provides insulation.
  - The high pressure (HP) subsystem, 265 psig nominally, provides SF_6 for arc extinguishing.

SF_6 Bus Duct Failures (1982-1989)

- **Insulator failures (8 total) attributed to:**
  - **Aluminum particle contamination, resulting in partial discharges and SF_6 breakdown (1 failure).**
  - **Loss of spring contact at the conductor surface resulting in a floating component (4 failures).**
  - **Voids between epoxy coating and the aluminum insert (2 failures).**
  - **Indeterminate (1 failure).**
- **Air bushing failures (2 total) attributed to:**
  - **Excessive mechanical loading from cable contraction during cold conditions.**
  - **Excessive mechanical loading from cable sway during wind conditions.**



SF6 INSULATOR

WITH CENTER CONDUCTOR

Consequences of SF_6 Bus Duct Failures

- **Zones 3, 6, and 7 – connect switchyard to 3 sets of overhead transmission lines. Loss of a single bus duct due to insulator failure required 8 days for repair at manufacturer's facility. Unit operation can continue with two sources of off-site power.**
- **Zone 2 – connects switchyard to reserve auxiliary transformers. Loss of capability to supply off-site power from two independent sources. Requires unit shutdown unless restored within 24 hours.**
- **Zone 4 – connects generator step up transformers to switchyard. Loss of electrical load requiring immediate reactor shutdown.**
- **Air bushing failures – loss of SF_6 gas inventory for affected zone (Zones 3, 6, or 7).**

1D12148

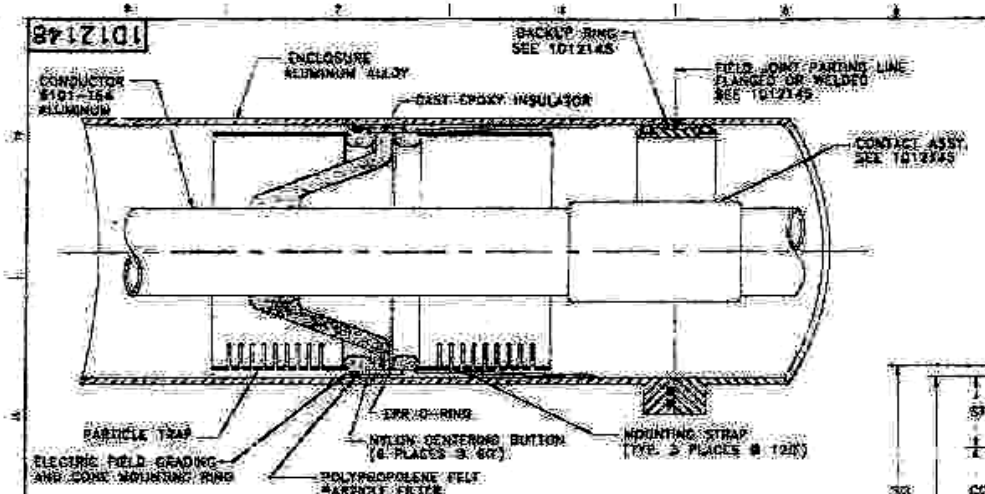


FIG.1 CONICAL INSULATOR FIXED GAS PASS WITH PLUG CONTACT

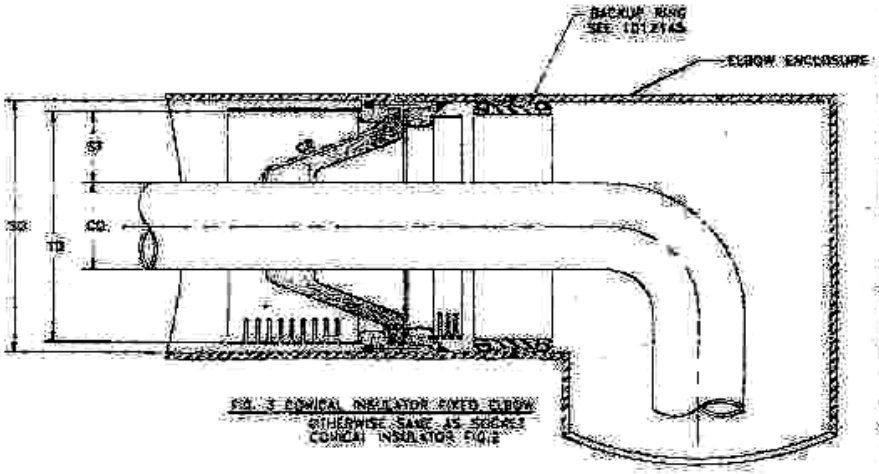


FIG. 3 CONICAL INSULATOR FIXED ELBOW
OTHERWISE SAME AS SOCKET CONICAL INSULATOR FIG.2

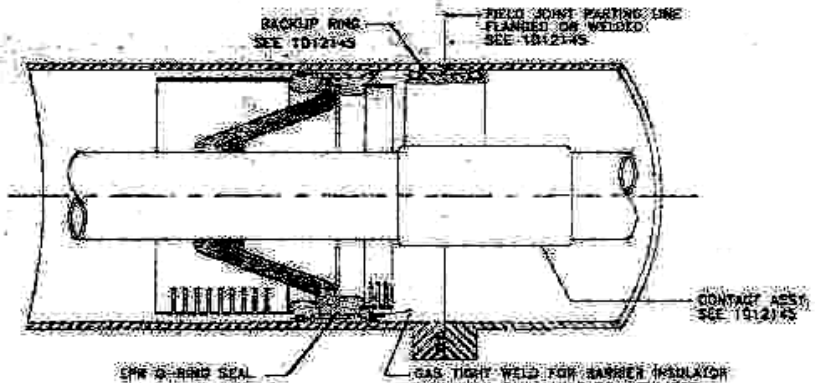


FIG.2 CONICAL INSULATOR FIXED GAS PASS OR GAS BARRIER WITH SOCKET CONTACT

SIZE	RATING kV	CD		SR		TD		ST	
		in.	mm	in.	mm	in.	mm	in.	mm
1	145	3.5	89	6.25	159	10.00	254	4.50	114
2	245	4.0	102	7.13	181	11.38	289	5.13	130
3	362	5.0	127	8.75	222	14.00	356	6.31	160
4	550	6.25	159	10.63	270	17.13	435	7.75	197
5	800	7.5	191	13.13	333	21.00	533	9.50	241
6	1100	9.0	229	15.63	397	25.13	638	11.38	289
7	1550	11.5	292	20.00	508	32.25	819	14.63	372

	INSULATOR	
	CONICAL OUTLINE	
	ABB	
		1D12148

Corrective Actions

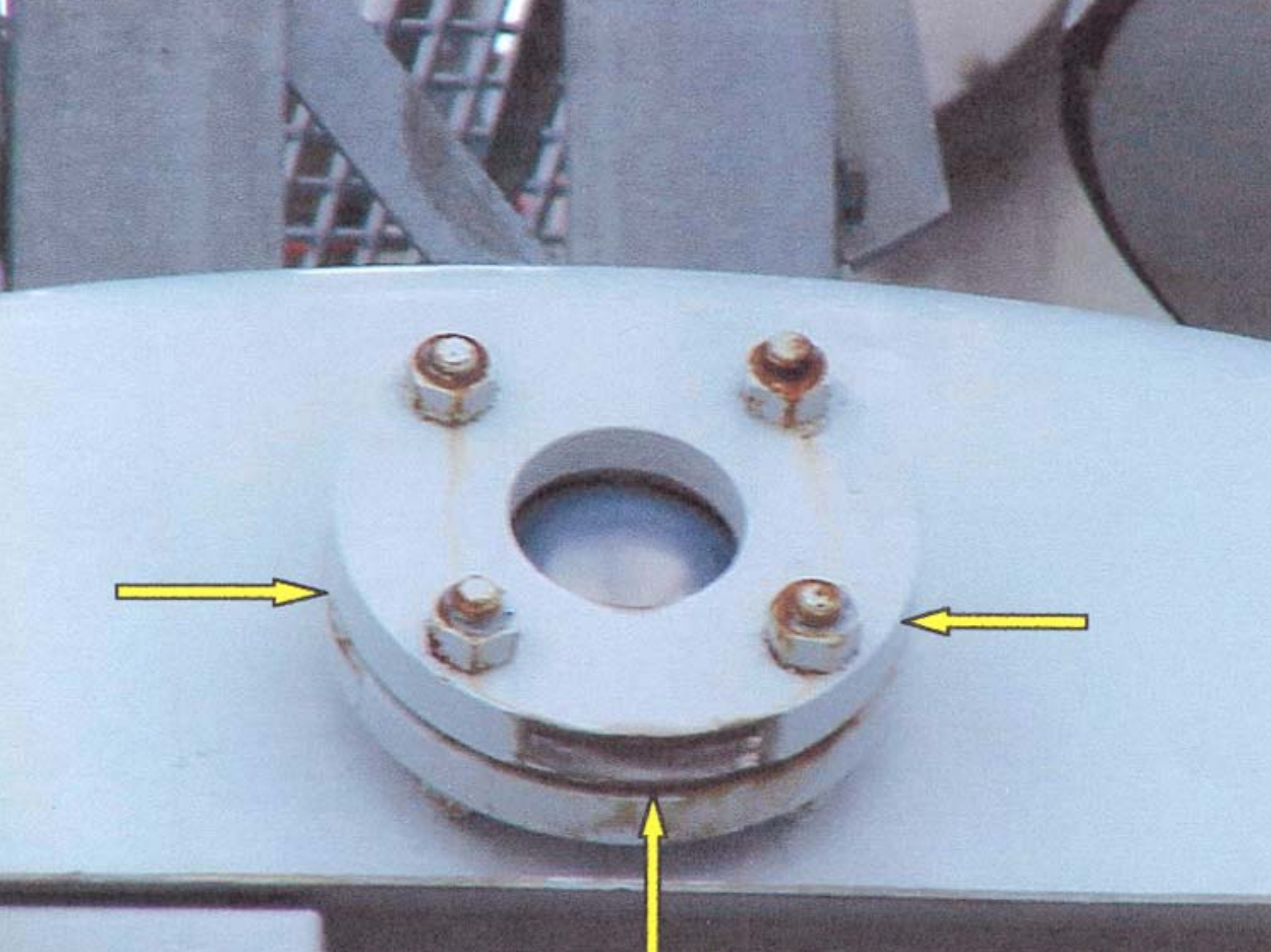
- **Bus duct modifications, Zones 2 and 4 – replace with new Westinghouse/ABB design.**
  - **Implemented in 1992 for Zone 2.**
  - **Implemented in 1997 for Zone 4.**
  - **Cost: $1.9 million.**
- **Porcelain air bushing replacement with epoxy composite bushings.**
  - **Replacement implemented in 1993, but not before two additional failures occurred in 1991 and 1992.**
  - **Cost: $900,000 for 9 composite bushings.**
- **Establish an on-site facility for repair of SF_6 bus duct sections and power circuit breakers.**
  - **Implemented in 1992.**
  - **Cost: $430,000.**

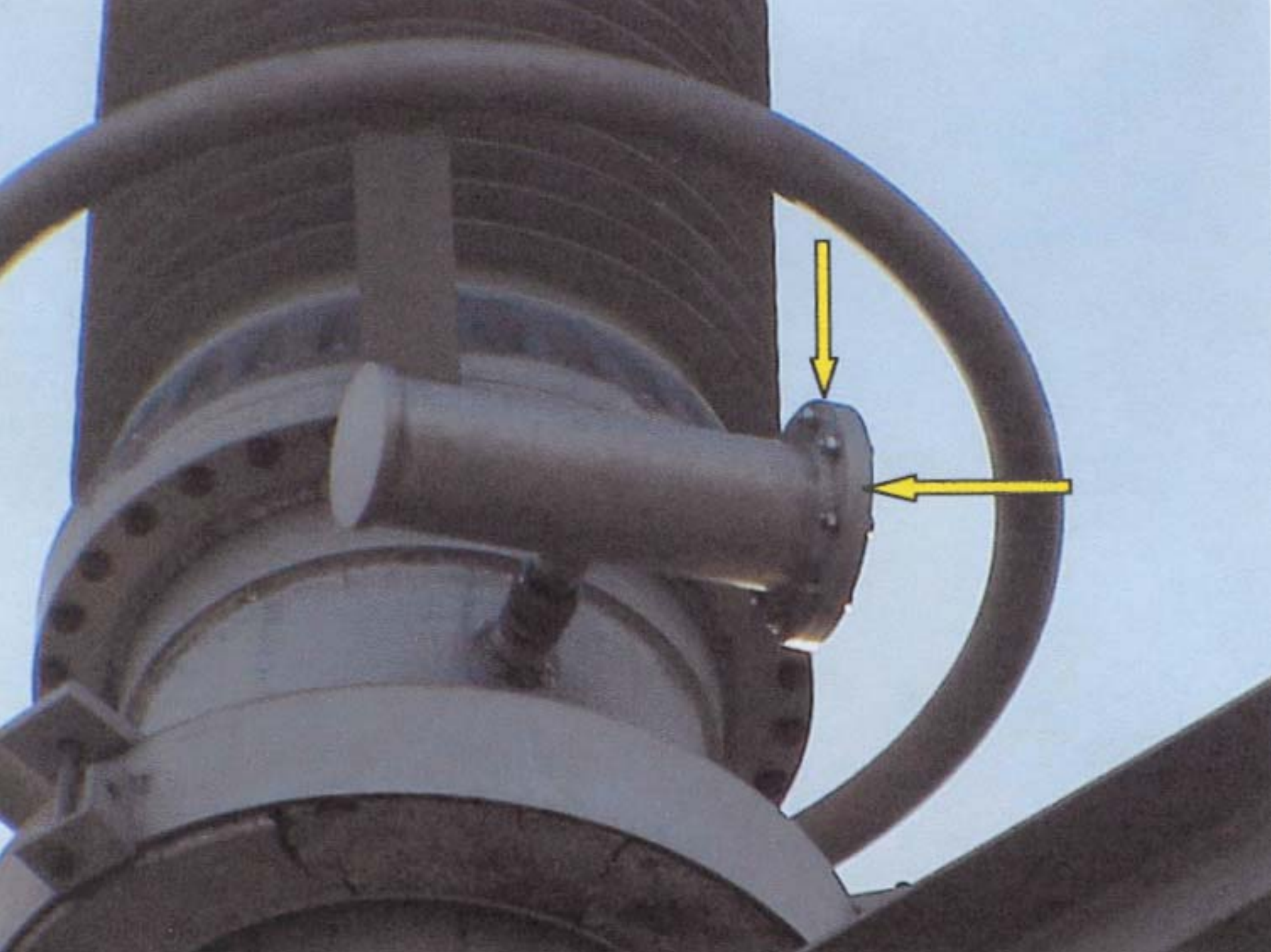
Performance Since Implementation of Corrective Actions

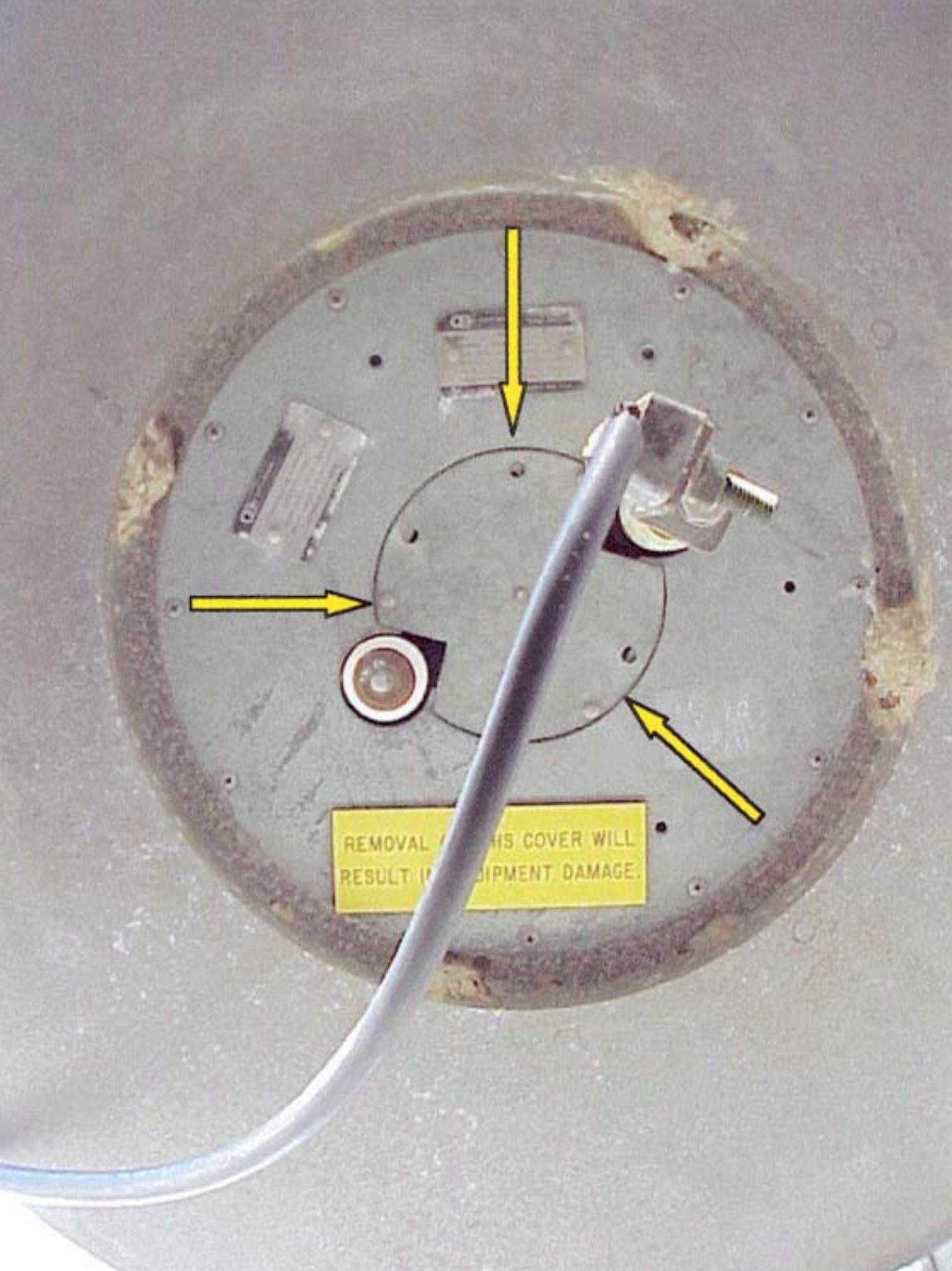
- No insulator failures experienced in Zones 2 or 4.
- Insulator failures continue at a rate of one per year in other zones.
- No air bushing failures since installation of composite bushings.
- On-site test and repair capability has reduced repair time from 8 days to 5 days on average.

Present Leakage Reduction Measures

- October 1999 EPRI Gas-Vue Leak Detection System survey of SF_6 bus ducts and power circuit breakers.
- Identified leakage areas have been reviewed and repair activities have been incorporated into the station maintenance schedule for 2000-2002.
- Follow-up survey planned following completion of repair activities.






REMOVAL
HIS COVER WILL
RESULT I
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