



An Exelon Company



# The ComEd Roadmap to Success

## SF<sub>6</sub> Emissions Reduction Strategy at ComEd Substations

*2012 Workshop on SF<sub>6</sub> Emission  
Reduction Strategies  
April 17-18, 2012  
Atlanta, Georgia*

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# ComEd Introduction

In 2006, ComEd Transmission and Substation (T&S) achieved ISO14001 certification which paved the way for all other organizations within ComEd. In 2008, the entire ComEd organization achieved ISO14001 certification. In 2011, the program was validated through recertification.

ComEd T&S has become a key player in achieving the Exelon 2020 Environmental goal of reducing its greenhouse gas emissions. T&S has driven down our leak rate from 10% in 2005 to a current leak rate of 0.91% in 2012 with a target of 4%

Annual targets and goals for SF6 reductions are set as part of the ComEd EMS plan. SF6 reductions contribute to ComEd's GHG reduction program and are one of the primary driving forces in our overall good performance



## On-going focus areas

ComEd T&S has enhanced its SF<sub>6</sub> management and leak reporting & repair by:

- ✓ Phasing out 1<sup>st</sup> Generation Breakers
- ✓ SF<sub>6</sub> Leak Reporting
- ✓ Employee Engagement
- ✓ SF<sub>6</sub> Leak Detection / Camera / PM Program
- ✓ SF<sub>6</sub> Handling Procedure / Training
- ✓ SF<sub>6</sub> Handling Equipment
- ✓ Rigor on cylinder reductions and tracking

With this enhanced SF<sub>6</sub> reduction strategy, ComEd T&S decreased it's leak rate in each of the past 7 years.

# Phasing out 1<sup>st</sup> Generation Breakers

## 765kV Bus-Tie Breaker removal

SF<sub>6</sub> gas evacuated

Parts removed used for repair of leaking Bus-Tie

Successful removal of a breaker position that was unneeded

Eliminated of Environmental risk of 1800 lbs of SF<sub>6</sub> (43 million pounds of CO<sub>2</sub>)

Additional 765kv breaker replacement in the work plan for fall of 2012 and the removal of 3600lbs of SF<sub>6</sub> gas from two additional breakers this fall as well.

To date, T&S has replaced 9 out of 12 of the 1<sup>st</sup> generation breakers with the remaining 3 to be replaced/evacuated by end of 2012.



Before



After

# Phasing out 1<sup>st</sup> Generation Breakers

## 765kV Bus-Tie Breaker Replacement



Before

1800lb capacity



After

300lb capacity

# SF<sub>6</sub> Leak Reporting



**EXELON ENERGY DELIVERY YELLOW – LL/OE COMMUNICATION**

Date: March 20, 2008                      CE-EN-112                      Effective Date: ASAP

**Alert Type: Environmental Bulletin**

**SF6 Leak Reporting**

Affected Department(s): Transmission Operations, Technical Services, T&S, DSO and ESD.

FUNCTIONAL AREAS AFFECTED													
AD	AM	BO	CM	CS	EA	EN	EP	EX	FM	GO	HR	IT	OP
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>					

Affected Level(s): All T&S and Area Operating Managers, FLS's and Field Crews. Communicate this and provide the sign off documentation.

**Summary:**  New expectation or  Revised expectation

Over the past few years Exelon Energy Delivery has implemented a proactive approach to leak and spill reporting for all oil handling and oil filled equipment. Sulfur Hexafluoride gas, SF<sub>6</sub>, used as insulation in certain types of electrical equipment, is a global warming gas, that, when released to the atmosphere, can trap heat in creating a greenhouse effect. SF<sub>6</sub> is a potent global warming gas. When released, the gas remains in the atmosphere over 1,000yrs and has a global warming potential 23,900 times that of CO<sub>2</sub>, meaning 1lb of SF<sub>6</sub> is equal to 23,900 lbs of CO<sub>2</sub>. A release of 1lb of SF<sub>6</sub> is equivalent in Greenhouse Gas emissions as driving 2 cars for a year. SF<sub>6</sub> leak reduction contributes to Exelon's achievement of an USEPA climate leaders initiative. The initiative requires Exelon to reduce Greenhouse Gas (CO<sub>2</sub>) 8% below the 2001 baseline year

**Purpose and Details of Change:**  
ComEd Energy Delivery will formalize the reporting of SF<sub>6</sub> leaks as "Environmental Events". The reporting process will be specific for SF<sub>6</sub> although the leaks or releases will be tracked as an "environmental incident". For example, when SF<sub>6</sub> is added into a particular piece of equipment due to potential leaks and or possible equipment deficiencies, we will report the amount added back into the equipment, as the amount that had leaked into the atmosphere. The new expectation will be to identify, report and make repairs to the equipment that is leaking to prevent future SF<sub>6</sub> leaks. The procedure CM-ED-332033 for adding SF<sub>6</sub> into circuit breakers in service, now has Level 1 checklists that will be used to track how much SF<sub>6</sub> was added back into the breaker and then in turn that check list will then be sent to the Environmental Coordinators via a fax (Fax Number 630/576-6351) and a phone call to the OCC reporting the leak (just like we currently practice for oil spills, battery acid and mercury spills), and the amount added will be reported as the amount that leaked. The intent is to proactively take control and put more rigor around leak identification, repairs and overall SF<sub>6</sub> usage. For more information, CM-ED-300001 describes how to handle SF<sub>6</sub> gas and how to minimize any potential releases.

Alerts Archived on EED Environmental WEB Page - <http://exelonwss.exeloncorp.com/eed/esih/environmental>

Method of Employee Notification throughout the company:

Environmental Alert-communicates the reporting requirement for SF<sub>6</sub> Yellow is a "Read and Sign" Communicated via morning safety huddles.

# SF<sub>6</sub> Leak Reporting / Employee Engagement

Please complete while working a release during the work week back shift, as well as, weekends, and holidays. Then forward completed sheet to the Regional ESD Environmental Coordinator the following business day.						
<b>ComEd ESD MATERIAL RELEASE LOG</b>						
PREPARED BY		OMS Ticket No.:		WorkOrder No.:	<b>06596613</b>	Priority: <b>20</b>
M. TITRE		Dispatcher:	at X	Duty FLS:	<b>Bill Lones</b>	
		EQUIPMENT #:	<b>L10345 BUS 4</b>		FLS Phone # <b>630-985-4050</b>	
TRANSFORMER #	<b>TSS103 Lisle</b>	OVHD		PAD	KVA	<b>34</b>
1. ComEd PERSON REPORTING RELEASE	<b>Terry @ OCC 815-463-2900/Blk. Pwr. 630-932-3702</b>					
2. DATE OF REPORT	<b>1/7/2009</b>	TIME OF REPORT	<b>0912</b>			
3. ON SCENE CONTACT	<b>Bill Lones</b>	OUTSIDE TELEPHONE #	<b>630-985-4050</b>			
4. LOCATION OF RELEASE (INCLUDE COUNTY AND ANY BODY OF WATER PRESENT).*						
STREET/RD	<b>TSS103</b>	CITY	<b>Lisle</b>	COUNTY	<b>DuPage</b>	
RIVER/LAKE	<b>None</b>	EED Area	<b>BOL</b>			
5. DATE OF RELEASE	<b>1/6/2009</b>	TIME OF RELEASE	<b>Unknown</b>			
6. MATERIAL RELEASED	<b>SF6</b>	QUANTITY	<b>ADDED 1.5 LBS</b>			
7. Area Affected (sq. feet)	<b>Atmosphere unknown</b>					
8. CAUSE OF RELEASE	<b>Equipment failure</b>					
9. EXTENT OF INJURIES	<b>None</b>					
10. CONTAINMENT/CLEANING ACTIONS UNDERTAKEN						
<b>1.5 lbs. SF6 added</b>						
11. COMMENTS	<b>Follow up with Environmental on what repair actions were taken.</b>					
<b>RELEVANT INFORMATION &amp; CONTACTS:</b>						
<b>NOTE: Mailing address (Environmental Services Department, Three Lincoln Center, 3rd Floor, Oak Brook Terrace, IL 60181-4260) for all follow-up correspondences. RD-116 letter is required by MWRD 5 calendar days after reportable release occurs.</b>						

# Engaging Employees in SF<sub>6</sub> Policies and Procedures

## ✓ Environmental Symposiums

Hosted by ComEd's T&S Leadership and Environmental Team in all four geographic regions with Managers, Operations Coordinators, Supervisors and Crew Leaders

## ✓ Substation Training

Starting 2008 for all Substation Technicians, six hands-on performance exercises were conducted and have been in yearly tech refreshers since.

## ✓ ISO 14001 Certification

ComEd employees at numerous facilities participated in this audit, in which ComEd has just recertified in late 2011



SF<sub>6</sub> Evacuation, Filling, and Recovery Hands-on Exercise (Shown Above)



## SF<sub>6</sub> Camera – Leak Scans/Winter Readiness/New Equipment



The use of the SF<sub>6</sub> camera, plus a preventive maintenance program has helped us identify SF<sub>6</sub> leaks quicker and reduce the amount of SF<sub>6</sub> released in the atmosphere. In 2009 T&S has implemented the process for a PM program on our first generation gas breakers to be scanned twice a year during our cold season which is incorporated into our “Winter Readiness Program”. To date there is a camera in each region and is used on a PM and CM basis.

Currently developing a “Ready to Start” checklist for newly installed SF<sub>6</sub> equipment, focusing on proactive scans prior to livening and then after being in service for 4 weeks.



# SF<sub>6</sub> Leak Prioritization Procedure



AM-CE-Y023  
Rev. 0  
Page 1 of 9  
Effective Date: 10/14/2010

FUNCTIONAL AREA													
AD	AM	CM	CS	EA	EN	EP	EX	FI	FM	GO	HR	IT	OP
	X	X			X								X
PC	QA	RE	SA	SM	TQ	VM	WM						
X							X						

## Substation Electrical Equipment SF<sub>6</sub> Leaks Inspection and Repair Prioritization

### 1 PURPOSE

1. Provide guidelines for collecting data from the SF<sub>6</sub> leak inspection on the equipment.
2. Classify the significance of the leakage based on the leakage rate, pressure indication of SF<sub>6</sub> remaining, capability of repairing the leak permanently, and estimating the serviceable period before taking the equipment out of service.
3. Setting the Priority as a 10 or 20 for monitoring, repair, and replacement of the equipment based on the information collected on the SF<sub>6</sub> leak and the opportunity to replace/repair the equipment.

This procedure does not cover the repair techniques for the equipment and does not address distribution equipment.

### 2 TERMS AND DEFINITIONS

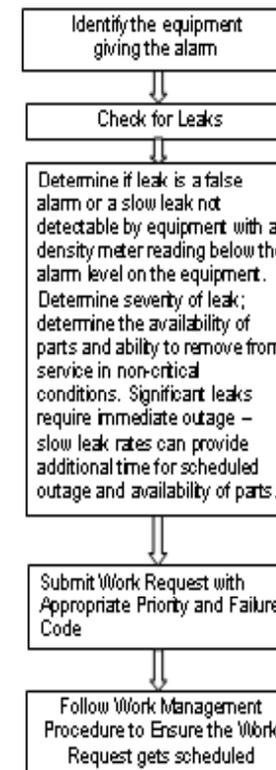
1. Refer to CM-ED-000010, EED Technical Glossary for technical terms and definitions.

### 3 ROLES AND RESPONSIBILITIES

#### 3.1 PROCEDURE WRITERS AND REVIEWERS

AM-CE-Y023  
REV 0  
Page 5 of 9

### 6.2 PROCESS TO PRIORITIZE REPAIR FOR SF<sub>6</sub> LEAKS



# SF<sub>6</sub> Handling / Addition Procedures



## Exelon Delivery

### Technical Procedure

#### Sulfur Hexafluoride Gas SF<sub>6</sub> Handling

CM-ED-300001

Rev. 2

Effective: 8/7/2009

(Supersedes: MP-4.2.3.3)

Level: 2

Page 1 of 25

#### 1. PURPOSE

To provide guidelines for provide direction for Exelon Energy Delivery (EED) and contract individuals involved in handling sulfur hexafluoride (SF<sub>6</sub>) gas, specifying safe working procedures for the maintenance and installation of equipment containing SF<sub>6</sub> gas.

To specify safe working procedures for:

- Handling SF<sub>6</sub> gas
- Filling SF<sub>6</sub> gas
- Removing SF<sub>6</sub> gas
- Recycling of hazardous by-products.

Section 5 Safety and Environment Concerns has been divided into the following subsections:

Subsection	Title	Page
5.1	Safety Measures	5
5.1.1	Suffocation Hazard	5
5.1.2	Decomposition Gases and Solid By-Products	6
5.1.3	SF <sub>6</sub> Handling	7
5.1.4	SF <sub>6</sub> Cylinders - Equipment Filling and Recovery	7
5.1.5	OSHA On Respiratory Protective Equipment	8
5.1.6	SSC Circuit Switcher Interrupters	8
5.2	Environmental Concerns	9
5.2.1	Greenhouse Gas	9

Section 8 has been divided into the following subsections:

Subsection	Title	Page
8.1	Hoses, Fittings and Accessories Care and Handling	10
8.1.1	SF <sub>6</sub> Cylinders	10
8.1.2	Service Hoses	12
8.1.3	Service Couplings, Valves and Fittings	12
8.2	Filling Equipment with SF <sub>6</sub> using a Gas Handling Apparatus Processing Cart	13
8.3	Filling Equipment with SF <sub>6</sub> using a Gas Handling Apparatus Transfer Cart / Cylinder	13
8.4	Filling or Topping with SF <sub>6</sub> from a Cylinder	14
8.5	Removal of SF <sub>6</sub> from In-Service Equipment	15
8.6	SF <sub>6</sub> Distribution System Switches	16
8.7	SF <sub>6</sub> Recycling Units and Filters	16
8.8	SF <sub>6</sub> Cylinder Weighing	17



## Exelon Delivery

### Technical Procedure

#### Adding SF<sub>6</sub> (Sulfur Hexafluoride) Gas To Circuit Breakers

CM-ED-332033

Rev. 1

Effective: 02/25/2008

(Supersedes M-E-141-601 and  
MP-4.2.3.4)

Level: 2

Page 1 of 1

#### 1. PURPOSE

To provide expectations for safely adding SF<sub>6</sub> gas to energized and on-line circuit breakers

Section 8 of this procedure has been divided into the following subsections

Subsection	Title	Page
8.1	Use Of Maintenance Log	9
8.2	Adding SF <sub>6</sub> to Single Pressure Circuit Breakers	10
8.2.1	Prepare Cylinder	10
8.2.2	Single Pressure Breakers Other Than FX32	11
8.2.3	For FX-32 Circuit Breakers	13
8.3	Adding SF <sub>6</sub> to 2 PRESSURE Circuit Breakers	16
8.3.1	Initial Checks	18
8.3.2	Triumphanchoring	19
8.3.3	Adding Gas	19
8.4	Restoration of Equipment	20

#### 2. TERMS AND DEFINITIONS

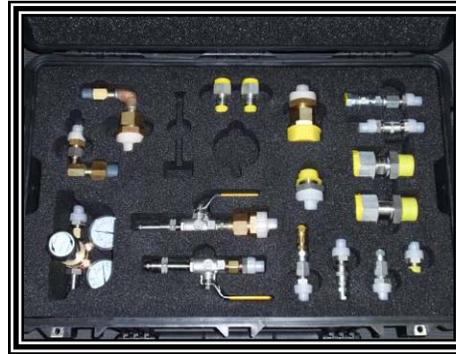


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## Featured SF<sub>6</sub> Substation Hands-on Training Equipment



Dilo SF<sub>6</sub> Reclaimer  
Model D320-R006  
(Front and Back)



ComEd Specific SF<sub>6</sub>  
Fittings and Adaptors Kit

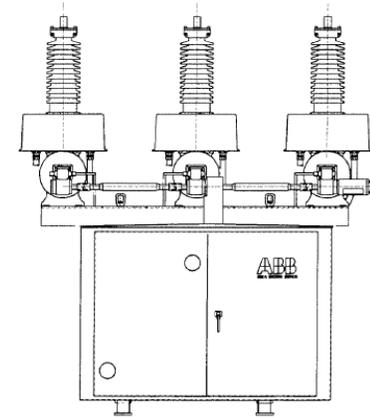


ABB Model 72PM  
Circuit Breaker

# SF<sub>6</sub> Recovery Equipment/Training

## ComEd Dilo Fittings and Adaptors Kit

Cutouts for the following items supplied by Com Ed:

COMPONENT	GRAPHIC
<p><b>Digital Thermometer</b> (Extech Model 1BP95) ComEd Cat ID 1612004</p>	 <p>Will fit in "Tray Insert" Cutout shown on the previous page of this document.</p>
<p><b>Digital Pressure Gauge</b> (Cecomp Electronics) 0-300 psig - ComEd Cat ID 1605183</p> <p><b>NOTE:</b> There are two other Pressure Gauge Ranges <b>not</b> to include in the kit: 0-500 psig – ComEd Cat ID 1606388 0-5000 psig – ComEd Cat ID 160????</p>	 <p>(For Illustration Only) Will fit in "Tray Insert" Cutout shown on the previous page of this document.</p>
<p><b>Plastic Parts Box</b> Number of Compartments 4 to 20, Number of Dividers 16, Overall Length 8 3/8 Inches, Overall Width 13 Inches, Depth 1 7/8 Inches</p> <p>Grainger Part Number 3KN88 Not Coded in ComEd PassPort</p>	 <p>Will fit in "Base Insert" Cutout shown on the previous page of this document.</p> <p>SEE NEXT PAGE FOR SUGGESTED CONTENTS</p>



SAMPLE PLASTIC PARTS BOX CONTENTS

## SF<sub>6</sub> Gas Reclaimer *Mega Plus Series*



### High Speed SF<sub>6</sub> Recycling without Compromises

- Up to 450 lbs. Per Hour Recovery
- Fully Automated Operation
- No SF<sub>6</sub> Gas Losses
- DOT Approved Storage
- No Contamination of SF<sub>6</sub>
- Safe and CFC free Liquefaction allows for Flexible Gas Storage Capacities
- Simultaneous Recovery & Vacuum
- Unequaled Protection Features
- 99.99% Recovery – Highest Available



# SF<sub>6</sub> USEPA Emission Rate Reporting

SF6 Emission Inventory Reporting			
Protocol and Form			
Annual Reporting Form			
Name: _____		Title: _____	
Phone: _____		Company: _____	
Reporting Year: _____		Date Completed: _____	
		Amt. (lbs)	Comments
<b>Change in Inventory (SF6 contained in cylinders, <u>not</u> in energized equipment)</b>	Inventory (In cylinders, not equipment)		
	1. Beginning of year	5000	
	2. End of year	3000	
	<b>A. Change in inventory (1 - 2)</b>	2000	
<b>Purchases / Acquisitions of SF6</b>	3. SF6 purchased from producers or distributors in cylinders	550	
	4. SF6 provided by equipment manufacturers with/inside equipment	250	
	5. SF6 returned to the site after off-site recycling	100	
	<b>B. Total Purchases/Acquisitions (3+4+5)</b>	900	
<b>Sales / Disbursements of SF6</b>	6. Sales of SF6 to other entities, including gas left in equipment that is sold	1500	
	7. Returns of SF6 to supplier	2500	
	8. SF6 sent to destruction facilities	200	
	9. SF6 sent off-site for recycling	250	
	<b>C. Total sales/Disbursements (6+7+8+9)</b>	4450	
<b>Change in Nameplate Capacity</b>	10. Total Nameplate capacity (proper full charge) of <u>new</u> equipment	2000	
	11. Total Nameplate capacity (proper full charge) of <u>retired of sold</u> equipment	1800	
	<b>D. Change in Capacity (10 - 11)</b>	200	
		<b>lbs SF6</b>	<b>Comments</b>
<b>Total Annual Emissions</b>	<b>E. Total Emissions (A+B-C-D)</b>	-1750	
		<b>Percent %</b>	<b>Comments</b>
<b>Emission Rate (Emissions/Capacity)</b>	Total Nameplate Capacity at End of Year	66994	
	<b>F. Emission Rate (Emissions/Capacity)</b>		

# SF<sub>6</sub> Usage / Cylinder Tracking Log

## SF<sub>6</sub> Usage Log

Region	Bottle Location	ComEd/ Vendor	Bottle Ser#	Date Used	Amt Used:	Equipment SF6 was added to:	Crew Ldr Name	Scale Ser #
South	Sta 23	Vendor	BUY467 turned in	1/4/2012	175	765KV BT 2-3	Pickworth	219848
South	Sta 23	Vendor	CZH666 turned in	1/10/2012	72	765KV BT 2-3	Murphy	219848
South	Sta 23	Vendor	EHP281 turned in	1/11/2012	22	765KV BT 2-3	Crawley	219848
South	Crestwood	Vendor	turned in--	1/16/2012	10	138KV L1322CB	Garza	219850

Follow Up Scan Date	Scan work order number	Results of Scan	Repair work order number	Scheduled Repair Date	Estimated Outside Temp when added	Indoor or Outdoor Gear
Cancelled(retire equip at end of 2012)	<<<<<<	<<<<<<	7403087-01	2/9/2012	25	Outdoor
Cancelled(retire equip at end of 2012)	<<<<<<	<<<<<<	7403087-01	2/9/2012	25	Outdoor
Cancelled(retire equip at end of 2012)	<<<<<<	<<<<<<	7403087-01	2/9/2012	25	Outdoor
1/20/2012	7405737-02	no leaks	7405737-01	1/16/2012	25	Outdoor

# SF<sub>6</sub> Usage / Cylinder Tracking Log

## Cylinder / Scale information

Region	Storage Location	ComEd or Vendor	Bottle Ser#	Bottle Tare Weight	Total Weight of Bottles:					Wt of SF6 End of 2010	2011 SF6 Usage	Scale Serial Number (2011 Wt)
					12/31/10	12/31/11	12/31/12	12/31/13	12/31/14			
South	TSS 61	Airgas	1CC3AA2265	119		236.1					117.1	219848
South	TSS 61	ComED	3AA2015	48.8		84.7					35.9	219848
South	Sta 12 Dresden	ComED - recovery Bottle	ICC3AA2015	110.9		110.9					0	219848
South	STA 23 Collins	Vendor	DKC550	119.8		225.1					105.3	219848

## SF<sub>6</sub> Scale Calibration Information

Region	Scale Serial Number	Scale Calibration Date (2011)	Ser # of Weight Used	Scale Calibration Date (2012)	Ser # of Weight Used
South	221514	3/6/2012	4K5H		
South	219850	12/27/2011	4K5H		
South	219848	12/28/2011	4K5H		
South	219840	12/28/2011	4K5H		
South	219290	12/27/2011	4K5H		

## Weight Certification Data

Region	Weight Serial #	Date Certified
South	4K5H	9/30/2011

# SF<sub>6</sub> Emissions Reduction Summary

- ✓ Newly installed equipment is scanned prior to livening
- ✓ Leak Prioritization Procedure AM-CE-Y023 was developed
- ✓ Newly revised tracking process for leaks, scan results, repair work order tracking, cylinders, scale and weight certifications.
- ✓ Focused initiatives work down yearly for repair and replacement of SF<sub>6</sub> equipment