

SF₆ Equipment Maintenance, Repair, and Replacement and Emissions Programs

U.S. EPA's 2012 Workshop
on SF₆ Emission Reduction
Strategies. April 17, 2012

ITC Holdings Corp
Mike McNulty, Environmental Department
Joe Jasinski, Asset Management



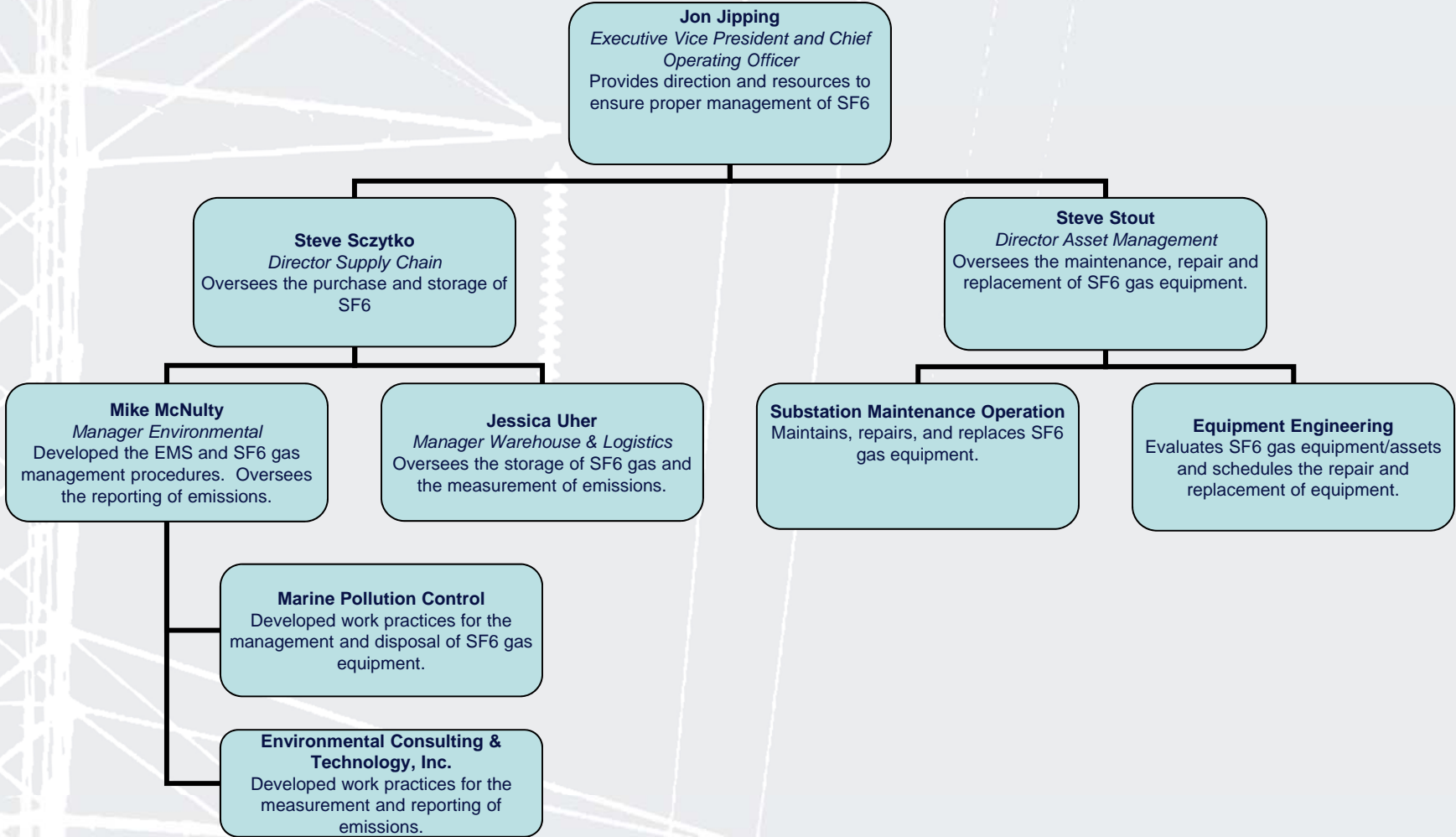
ITC Holdings Corp – Who We Are

- ITC Holdings Corp is the largest independent electricity transmission company in the United States
- ITC was founded in 2003
- ITC has four business units:
 - Michigan Electric Transmission Company (METC), MI
 - ITC *Transmission*, Southeast MI
 - ITC Midwest, IA, MN, IL
 - ITC Great Plains, KS, OK




ITC Holdings Corp

SF₆ Emissions Monitoring and Reduction Team



ITC Holdings Corp – Environmental Management System Regarding SF₆ Gas Emissions

 **SF₆ GAS EMISSIONS TRACKING WORK PRACTICE
WAREHOUSE CYLINDER LOG SHEET – FORM 1**

NAME OF WAREHOUSE: _____

Date Checked Out	Cylinder Serial Number	ULC/ITC Employee Checking out Cylinders	Date Returned	Warehouse Personnel Signature

Note: This log is to only be used for SF₆ gas cylinders

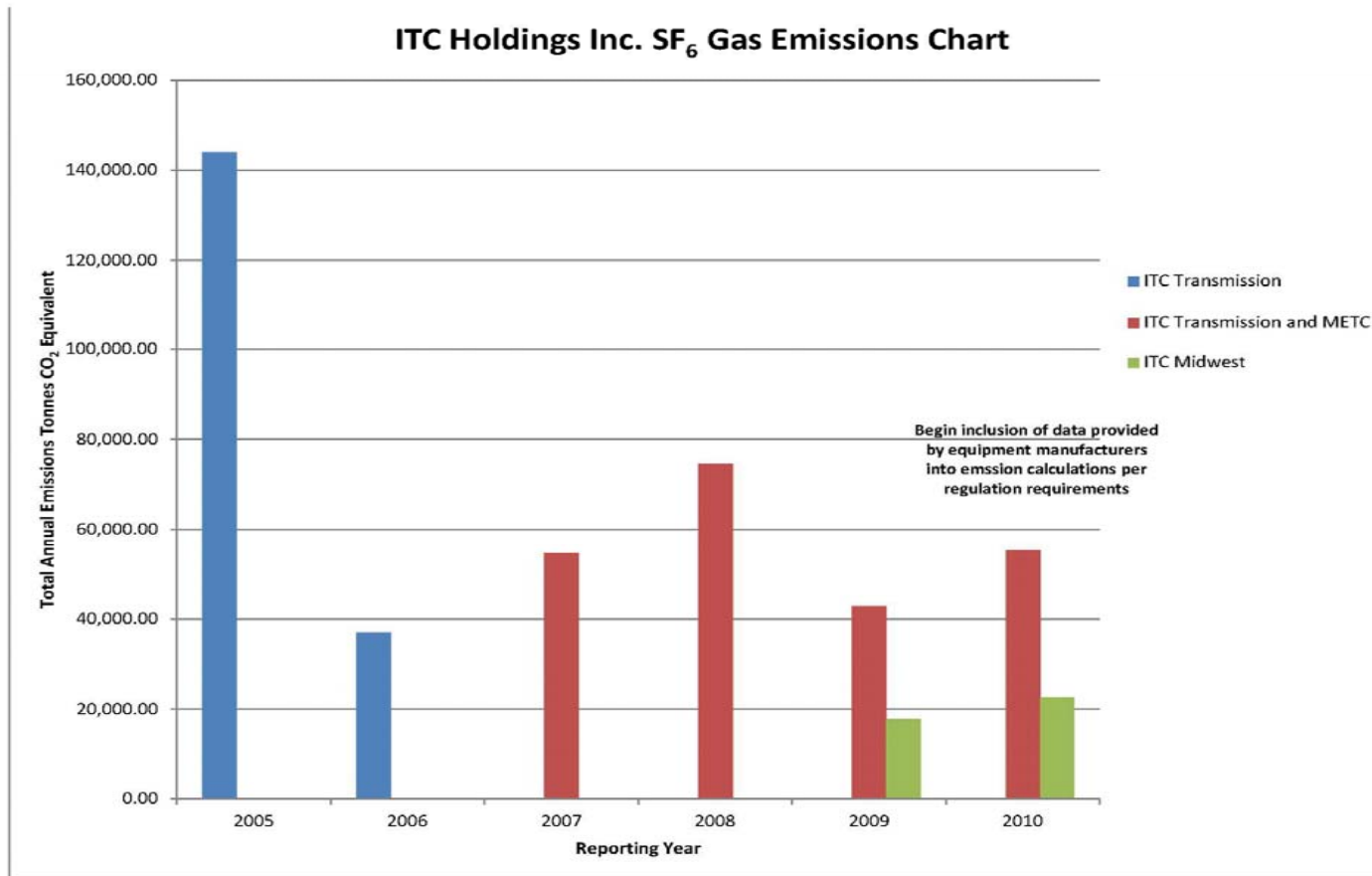
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- ITC has developed and implemented an ISO 14001 based Environmental Management System
 - 23 Environmental Procedures
 - 28 Environmental Work Practices/Policies
- SF₆ Gas Emissions Tracking WP and Greenhouse Gas Monitoring Plan
 - spells out roles and responsibilities
 - guidance on the weighing, storage, labeling, and inventory of gas cylinders
 - Warehouse Cylinder Log Sheet
 - Guidance on the measurement, calculation, and reporting of emissions



Results of SF₆ Reduction Efforts



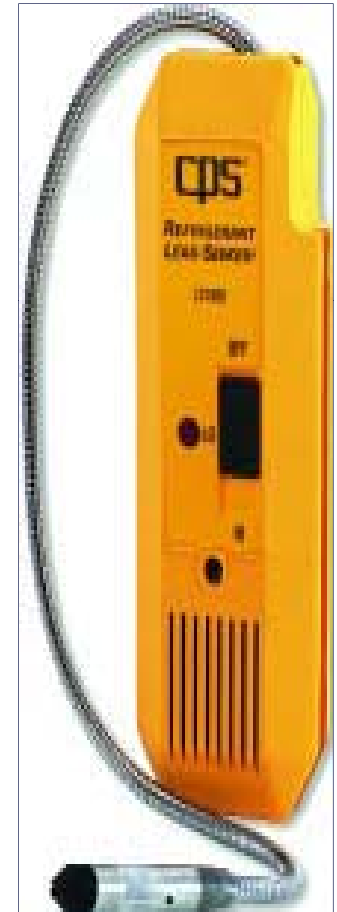


ITC Initiatives to Reduce SF₆ Emissions

- ITC is reducing its SF₆ gas emissions through two key programs
 - Preventive maintenance program
 - Maintenance
 - Leak Detection – Proactive Approach
 - Equipment Repair
 - Infrastructure improvement program - equipment replacement
 - Gas Insulated Switchgear (GIS) Station Replacement
 - Circuit Breaker Replacement – with SF6 Gas Breakers
 - Older SF6 Gas Breakers
 - Older Oil-Filled Breakers

Preventive Maintenance Leak Detection

- Leaks identified - the low-gas density alarm included with the circuit breaker
- Problem recorded in Asset Sentry
 - work request is issued to identify/repair leak
 - Don't just add gas to raise pressure
- Actively investigate leaks via the “leak kit”
- Inexpensive electronic leak detectors
 - Thermometer
 - CPS brand refrigerant leak detector, Model LS790B
 - Snoop liquid leak detector
- Leak history investigated during pre-breaker preventative maintenance
 - Avoid subsequent shutdowns
- Repair leak avoiding future refill visits and associated costs
 - Install bolted-on clamp/seal rings around leaking gas breaker bushings
 - Repair gas breaker tube fittings
 - Replace seals at interrupter flanges





SF₆ Response Procedure

- At the breaker, the bottom of cabinet enclosure is checked first for the presence of SF₆ with the leak detector. Helps troubleshooting leak inside (or outside) breaker.
- Gas pressure is raised to the max fill amount. Details of the As-Found / As-Left Temperature and Pressure are recorded for communication to TSC / Dispatcher (for Exception closure).
- Attempt will be made by the crew to pinpoint the leak location and fix the leak(s) when possible.
- Unsuccessful leak location & repair will prompt creating exception for outage RE: Leak locate & repair. The Region foreman submits the EOR when ITC Asset Management approves this exception.

Asset Sentry – SF₆ Leak Exception Report

AssetSentry: Exception Report - Windows Internet Explorer
 https://www.secure.assetsentry.com/exception_report.aspx?e=41979&id=1967

File Edit View Favorites Tools Help

ITC AssetSentry Exception Report

ITC **Asset Sentry** **Exception Report** **ITC MIDWEST** **ABB**

No Alerts

EQUIPMENT INFORMATION Criticality Index Unknown [Return to Equipment Tree](#)

Description		Equipment ID [1967]	Subtype	Responsible Indiv.		
BEVERLY SF6 GAS BREAKER: 7360 (161KV)		BEVERLY-BRKR-7360	SF6 GAS BREAKER			
ITC Area	Substation / Circuit	Component Class / Scheme	Position	Operating Voltage	Voltage Class	BES
SUBSTATIONS	BEVERLY	CIRCUIT BREAKERS	7360	161KV	161	Yes
Critical	Status?	IN/OUT OF SUB	PROTECTS WHAT		Part of Integrated Area	
NO	Active				YES	

EXCEPTION GENERATED ON 1/18/2012 AT 5:32:05 AM CDT **EXCEPTION CLOSED ON 1/18/2012 AT 9:35:35 PM CDT BY LINEBAUGH, JOSH**

ID	Condition Status	Initiated By	Assigned To	Technology	Priority	Exception Status
41979	Pending	Welker, Ryan	Unassigned	CORRECTIVE MAINT	A - URGENT	Closed

[View Exception List](#) [Send Update Notification](#) [Active Notifications](#)
[View Exception History](#) [Printable Version](#) [Notification History](#)

[General Info](#) [Work Status](#) [Cost Benefit](#) [GPS](#)

GENERAL INFORMATION

ITC Work Order
M570771; REACTIVE - 161 KV GAS BREAKER/SWITCHER MAINTENANCE

Work Task Type
REACTIVE MAINTENANCE

Line Designation

Problem Description	Failure Codes	Reference Image
TSC reports low SF6 alarm. Please have operator inspect in a.m.		
Analysis Comments	Root Causes	Diagnostic Image
		Audio

Done

SF₆ Gas Detection FLIR Camera

- Worse performers surveyed throughout system with FLIR camera
- Check for leaks otherwise inaccessible/dangerous places without the need for a shutdown
 - Bushings
- Used the camera to pursue known manufacturing defect on ABB 145PM breakers (bushing flange corrosion)
 - Repaired 17 in 2011

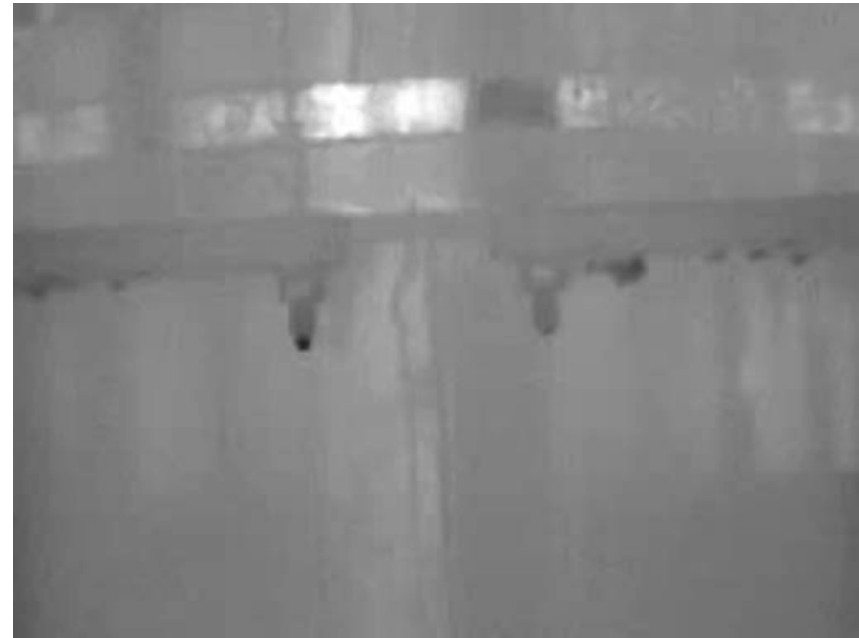


FLIR Camera in Action

Cato GIS Disconnect Leak



Conventional Photo



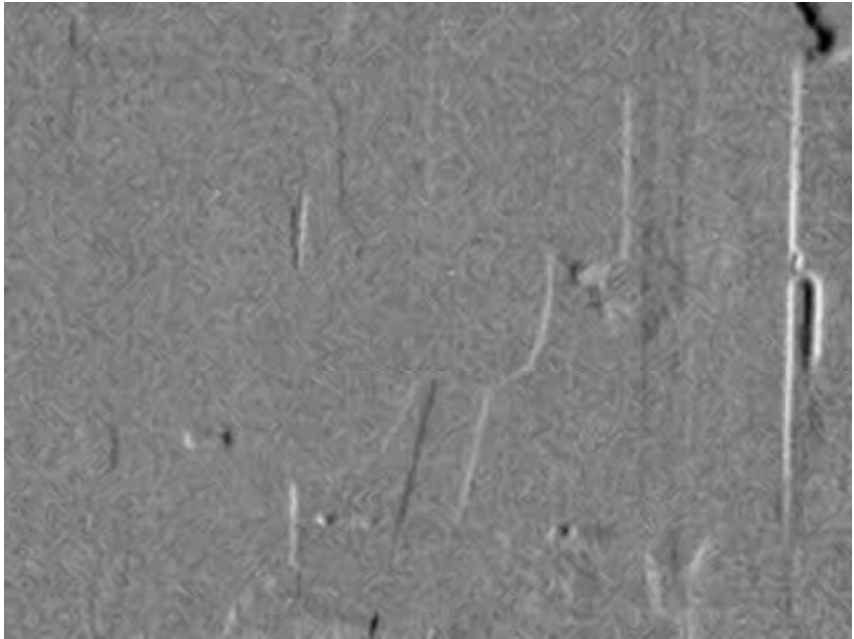
FLIR Camera Screen Shot

FLIR Camera in Action

GE-Hitachi HVB145 Breaker Defect



Conventional Photo



FLIR Camera Screen Shot

SF₆ Gas Recovery and Purification

Applications

- Recover and filter SF₆.
- Evacuate air and moisture prior to filling equipment.
- Cylinder transfer
- Liquid storage

12 Dilo Trailers in ITCT, METC and ITCM

Dilo SF₆ Trailer



DILO SF₆ Gas Reclaim Trailer



SF₆ Gas Recovery and Purification

Liquid-Liquid Transfer Trailer

- Quick and efficient means of transferring liquid SF₆ and consolidating cylinders
- Provides means to separate contaminants in gaseous form



Gas Insulated Switchgear (GIS) Replacement Project



Original St. Antoine ITC GIS

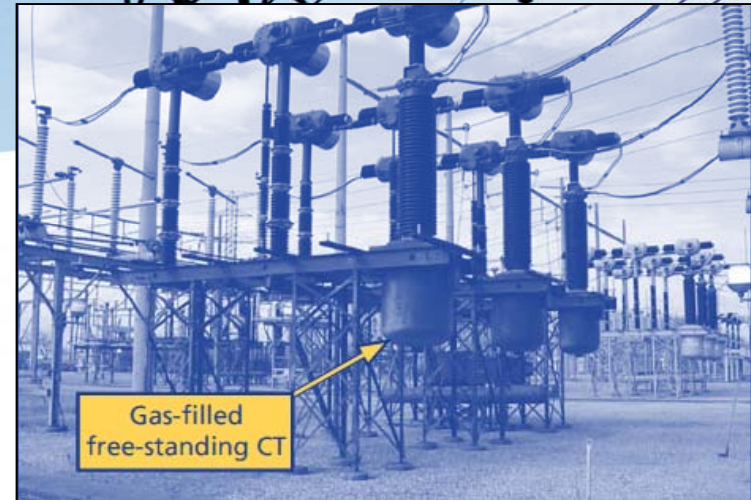


New St. Antoine MEPPI GIS

- Acquired five in-service GIS sites manufactured between 1970 and 1972
 - St. Antoine , Caniff, Midtown, Goss and Cato
- GIS substations were a significant source of SF6 emissions
 - Leaks and intensive maintenance
- ITC has replaced 4 of the 5 stations at a cost of about \$10,000,000 per station
 - Cato Station is being replaced this year.
- Replacement has resulted in a significant reduction in emissions and recovery of reusable SF6 gas
- GIS replacement at the St. Antoine site alone
 - Eliminated approximately 104 man-hours of labor in the winter and 24 man-hours in the summer
 - eliminated purchase approximately 16 cylinders of SF6 gas annually (about 1,840 pounds) to replace losses from the leaking equipment.

Circuit Breaker Replacement Project

- Maintenance costs and performance records of leaking equipment are compared to cost of replacement and additional benefits of new equipment
- ITC has selected variations of SFMT models supplied by Mitsubishi Electric as its equipment replacements
- Since beginning the circuit breaker replacement project in 2004, ITC has replaced or decommissioned 81 SF6 circuit breakers
- The cost of breaker replacement ranges from \$200,000 for a 120kV breaker up to \$500,000 for a 345kV breaker



GE ATB-7 with free standing gas CT



Mitsubishi 300SFMT-63E
with slip-over non-gas CTs



Thank You

Any Questions?

Joseph Jasinski
Asset Management – Senior Engineer
(248) 946-3266
jjasinski@itctransco.com

Mike McNulty
Supply Chain – Environmental Manager
(248) 946-3392
mmcnulty@itctransco.com

