



Draft

Substation Fire Fighting

Revision 7

A.U.C. 338
March 2013

1. INTRODUCTION

- 1.1 The Department in conjunction with Con Edison has developed a protocol for controlling fires on electrical equipment. Once a transformer has suffered a catastrophic failure which results in a fire, the breakers supplying transformer open automatically. So essentially, members will not be fighting "energized" fires. However equipment surrounding the failed transformer will in most cases remain energized. The protocol discusses the initial considerations, size-up, hazards along with recommended suppression agents. In addition to Con Edison there are seven other power providers in New York City; this policy can be applied universally since all these facilities have similar equipment.

2. PURPOSE

- 2.1 Failed transformers cannot be salvaged and are of no useful value to the utility. The intention of this protocol is to prevent collateral damage from fire & smoke impinging adjacent equipment which can result in large scale blackouts. This would compromise civilian safety and over-tax the response capabilities of the first response community.

3. UTILITY TERMINOLOGY

- 3.1 Utilities classify electrical equipment at their facilities as follows:
- 3.1.1 **Energized:** Equipment that is connected to an electrical source. *Illustrated in attachment 7.1*
 - 3.1.2 **De-energized:** Circuit breakers supplying the equipment are open. No power is flowing but is treated as "Live" since the equipment is not isolated and grounded. *Illustrated in attachment 7.2*
 - 3.1.3 **Isolated:** A physical break exists and equipment is isolated from all electrical sources but is not grounded. A static charge can remain on the equipment and is treated as "Live". *Illustrated in attachment 7.3*



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- 3.1.3 **Grounded:** The equipment is deenergized, electrically isolated and grounds have been applied. Essentially the equipment is safe to touch. When the equipment is grounded you may use any suppression agent at any distance since the electrical hazard has been mitigated.
- 3.1.4 **Burned Clear:** The conductor(s) supplying power to the transformer were burned clear by the fire. The transformer is no longer connected to the electrical system in the substation. *Illustrated in attachment 7. 4*
- 3.2 Power Providers: In addition to Con Edison there are seven other power companies operating within the City spanning fifteen locations. A list of those companies along with their locations and contact information has been provided as Attachment 7.5.
- 3.3 White Hat: ConEd employees all wear blue hard hats. The ConEd representative in charge of the emergency is identified by wearing a white hard hat. This policy only applies to Con Edison. When operating at facilities other than Con Edison, Chief Officers should clearly identify the utility representative in charge and instruct them to remain at the Command Post.
- Note: For example, employees at the Trans-Canada Generating Station on Vernon Boulevard in Long Island City all wear white hard hats- remember this is only a ConEd policy.*
- 3.4 Tracking: Smoke can become a conductor causing a phenomenon called tracking. In this case smoke can act as a bridge (track a path to ground) and allow power to flow from the conductor to ground. A water fog pattern can be used to control the direction of smoke and push it away from electrical equipment.

4. FIELD TESTING

- 4.1 April 2007: Joint testing was completed with Con Edison at a 345,000 volt substation to determine the safe standoff distance for the application of water on or near energized equipment. Testing enabled us to determine the safe standoff distances for water using various spray patterns.



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- 4.2 March 2010: Several suppression agents were tested at 50,000 volts by Safety, R&D along with ConEd to determine which ones were safe to use in a high voltage environment.
- 4.3 October 2010: F-500 produced the desired results. Another round of joint testing was conducted with Con Edison using F-500 Encapsulating Agent in one of their 345,000 volt substations. This is the highest voltage members can encounter operating in New York City. The test process determined that the standoff distances previously outlined in AUC 338 for water can also be applied to the use of F-500 Encapsulating Agent. A chart correlating those distances can be found below.

Table 1				
Voltage KV (phase – phase)	Distance to Nearest Equipment (feet)		Equivalent Hose Lengths	
	30-Degree Fog Spray	Other Streams	30-Degree Fog Spray	Other Streams
138	15	75	< 1	1 1/2
230	20	90	See Note 1	
345	25	125	1/2	2 1/2
500	30	135	See Note 2	

Note 1 - 230 kV limited to Goethals Substation in Staten Island – treat 345 kV

Note 2 – 500 kV limited to Ramapo Substation in Rockland County

5. RESPONSE PROTOCOL

- 5.1 The decision to apply water, foam, Purple-K or F-500 on or near electrical components will not be undertaken by first responding units. This decision can only be made by a Deputy Chief or above following a consultation with the utility representative in charge.



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6 SIZE-UP

- 6.1 Sustained Arcing: Officers should look for this condition on arrival. When a transformer fails the breakers supplying the unit will trip similar to how the breakers in your home clear a fault. If a breaker fails to open and clear the fault, power will continue to feed the fault. This condition will appear as a bright blue flame with a pronounced humming sound which will be accompanied by one of two scenarios. The equipment will continue to fail and bum clear resolving the issue or there may be a violent failure resulting in an explosion. First due units should position a block from the facility in order to protect members. Members cannot suppress or contain this condition; it can only be resolved through the utility by opening additional breakers. *Illustrated in attachment 7. 7.is the appearance of a normal fire vs. a sustained arcing condition.*
- 6.2 Staging: As stated above, the potential exists for secondary explosions at these facilities during a fire. The Incident Commander can consult with the utility representative about the potential hazards.
- 6.3 PCB's: Consider all smoke and liquid to contain PCB's. Members should don masks when operating at any utility fires. *Note: Do not stage apparatus in a position to be contaminated by smoke generated from the fire.*
- 6.3.1 Decontamination: In the absence of PCB tests results, members who were exposed to the smoke or liquid should go through the decontamination process. The HazMat Battalion will serve as the subject matter expert in this area and should be assigned to the box.
- 6.5 Hydrant: Before taking a hydrant the Engine should look to flush the hydrant for three to five minutes in order to clear out any sediment conditions. Sediment such scale (brown water) in the stream promotes the flow of current. If conditions do not improve, find an alternative water source.
- 6.6 Utility Briefing: The following questions should be discussed with the utility representative on arrival.



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- 6.6.1 Pumphouse Fire: These facilities supply insulating oil at an elevated pressure to the high voltage underground feeders. The loss of oil pressure can cause the caps called potheads that keep the oil in the feeder to explode. The utility must deenergize every high voltage line that is pressurized by the affected pumphouse to eliminate the potential for secondary explosions prior to beginning suppression operations.
- 6.6.2 Deluge System: Is the transformer equipped with a deluge system. If the system is activated and has not suppressed the fire, consider shutting down the system as it may over-run the containment moat. This will potentially spread PCB contaminated oil on members, hose and apparatus.
- 6.6.3 What is the status of the affected equipment?
- Denergized, isolated and or grounded
 - *See decision making guide illustrated in attachment 7. 6.*
- 6.6.4 What is the highest voltage in the facility?
- Standoff distances for suppression operations will be determined by the available suppression agent.
 - In terms of personal safety or placement of apparatus maintain 20' clearance from all conductors. All tools such as hooks or ladders must be carried below the shoulder.
- 6.7 Apparatus: If the decision is made to position the apparatus inside a substation or generating station to conduct suppression operations the apparatus must be grounded by utility personnel. This is done because the electrical fields within these facilities can cause a static charge to build up on the apparatus since it is insulated from ground by its rubber tires. This is not necessary when operating from the street. In the event that a tower ladder is put into operation it must remain a minimum of 20 feet from all surrounding conductors. Utility personnel will direct the position of the tower ladder for safety. *Note: After having been positioned by the utility representative, members should not articulate the bucket without the guidance of the utility representative.*



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- 6.8 Appliances: The consideration for type of attack will be dependent upon the location of the fire, required standoff distance and product. Manned tower ladders, deck guns and hand lines may be used at the digression of the Deputy Chief as long as required standoff distances are maintained.
- 6.9 Suppression Agents: This section will expand on the use of water, F-500, Flouropolydol, Universal Gold AFFF-AR & Purple-K.
- 6.9.1 Water: The use of water should be limited to protecting exposures and controlling smoke. Attempts to use water to suppress a transformer fire may result in a "Boil-Over" given the normal elevated temperature of the oil inside the transformer.
- 6.9.2 Water Standoff Distances: For Live, Denergized or Isolated Equipment
- 15 feet on live 138 kV electrical components for 30° or greater fog streams
 - 75 feet on live 138 kV electrical components for all straight or solid streams
 - 25 feet on live 345 kV electrical components for 30° or greater fog streams
 - 125 feet on live 345 kV electrical components for all straight or solid streams
- 6.9.3 Drafting: If consideration is given to employing the use of a marine unit or in absence of a viable water source, drafting may be conducted providing the following: All electrical equipment that salt water may contact must be denergized, isolated and grounded given the high conductivity value of salt water.
- 6.9.4 F-500 Encapsulator Agent: This product is used exclusively by Con Edison. They will supply the product via five-gallon cans. ConEd will also supply large caliber fixed monitors and a 2 Y2 eductor that will enable members to draw from the five-gallon containers.
- 6.9.5 F-500 Standoff Distances: For Live, Denergized or Isolated Equipment
- 15 feet on live 138 kV electrical components for 30° or greater fog streams
 - 75 feet on live 138 kV electrical components for all straight or solid streams
 - 25 feet on live 345 kV electrical components for 30° or greater fog streams
 - 125 feet on live 345 kV electrical components for all straight or solid streams



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- 6.9.6 Universal Gold AFFF- AR Standoff Distances: None- all equipment that may be contacted with Universal Gold must be Deenergized, Isolated & Grounded. At this point standoff distance is unimportant since the electrical hazard has been mitigated with the application of the ground.
- 6.9.7 Flouropolydol Standoff Distances: None- all equipment that may be contacted with Flouropolydol must be Deenergized, Isolated & Grounded. At this point standoff distance is unimportant since the electrical hazard has been mitigated with the application of the ground.
- 6.9.8 Purple-K Standoff Distances: None- this product has a Class Crating and may be discharged on or near live equipment at any distance. ***Note:** This product offers no cooling value so success in suppressing these types of fires may be limited.*
- 6.9.9 Grounding: In the event that a transformer is "burned clear" grounding will not be necessary since the connections no longer exist to apply grounds. However any equipment that remains connected to the substation grid must be grounded if it has the potential to be contacted by Universal Gold or Flouropolydol.



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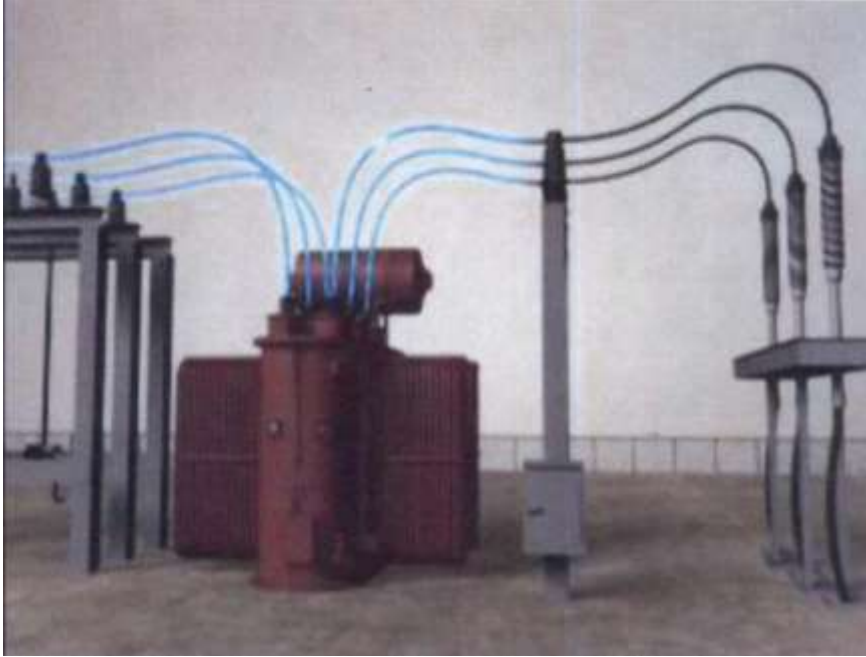
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7 ATTACHMENTS

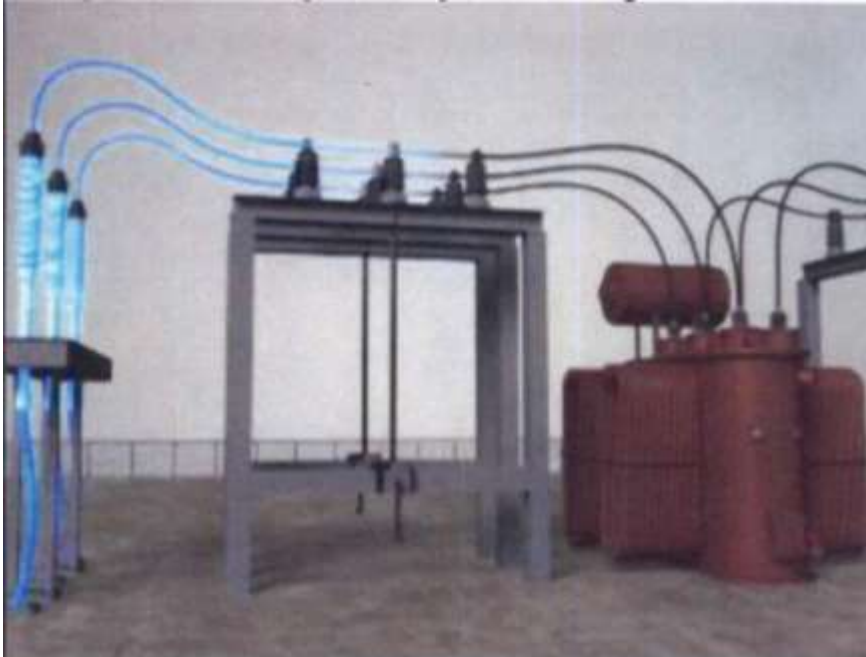
Attachment 7.1

Energized: Breaker is closed and power is flowing into transformer



Attachment 7.2

Deenergized: Breaker is open and no power is flowing into transformer





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Attachment 7.3

Isolated: A physical break in the path of the conductor. Figure 1 shows closed and Figure 2 shows open.



Figure 2





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Attachment 7.4

Burned Clear: The initial explosion and subsequent fire damages the connection point between the transformer and the conductors. Illustrated below – the conductors hanging on all three phases.





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Attachment 7.5 NYC Power Companies

Non Con Edison Owned Generating Contract Information			
Owner	Generator	Phone Number	Address
Astoria Energy	Astoria Energy 1	(718) 683-0452	19 th Ave and Steinway Place, Queens
	Astoria Energy 2	(718) 683-0452	19 th Ave and Steinway Place, Queens
Astoria Generating Company L.P.	Astoria #2	(718) 204-3815	1801 20 th Avenue, Queens
	Astoria #3	(718) 204-3904	1801 20 th Avenue, Queens
	Astoria #4	(718) 204-3905	1801 20 th Avenue, Queens
	Astoria #5	(718) 204-3931	1801 20 th Avenue, Queens
	Narrows Gas Turbines Barge #1	(718) 492-6179	53 rd & 1 st , Brooklyn
	Narrows Gas Turbines Barge #2	(718) 492-6185	53 rd & 1 st , Brooklyn
	Gowanus Gas Turbines Barge #1	(718) 499-1301	420 2 nd Avenue, Brooklyn
	Gowanus Gas Turbines Barge #2	(718) 499-1301	420 2 nd Avenue, Brooklyn
	Gowanus Gas Turbines Barge #3	(718) 499-1301	420 2 nd Avenue, Brooklyn
	Gowanus Gas Turbines Barge #4	(718) 499-1301	420 2 nd Avenue, Brooklyn
	Gowanus Gas Turbines Barges	(516) 790-1967	420 2 nd Avenue, Brooklyn
NRG Power Marketing LLC	Astoria Gas Turbines	(718) 274-8208 (718) 274-8937 (917) 612-8148	20 th Avenue & 31 st St., Queens
	Arthur Kill #2	(718) 390-2748	4401 Victory Blvd., Staten Island
	Arthur Kill #3	(718) 390-2758 (917) 612-8149	4401 Victory Blvd., Staten Island
New York Power Authority	NYPA CC1 & CC2	(718) 626-5834	20 th Avenue & 31 st St., Queens
	Hell Gate Gas Turbine 1	(315) 792-8228	E. 134 th St. & Locust Avenue, Bronx
	Hell Gate Gas Turbine 2	(315) 792-8228	E. 134 th St. & Locust Avenue, Bronx
	Harlem River Gas Turbine 1	(315) 792-8228	E. 132th St. & St. Anne's Place, Bronx
	Harlem River Gas Turbine 2	(315) 792-8228	E. 132th St. & St. Anne's Place, Bronx
	Pouch Terminal Gas Turbine	(315) 792-8228	345 St. & Mary Av., Staten Island
	Gowanus Gas Turbine 5	(315) 792-8228	East 23 rd St. & 3 rd Avenue, Brooklyn
	Gowanus Gas Turbine 6	(315) 792-8228	East 23 rd St. & 3 rd Avenue, Brooklyn
	Kent Avenue Gas Turbine	(315) 792-8228	North First St & River Street, Brooklyn
	Vernon Gas Turbine 2	(315) 792-8228	Vernon Blvd & 40 th Avenue, Queens
	Vernon Gas Turbine 3	(315) 792-8228	Vernon Blvd & 40 th Avenue, Queens
Calpine Energy Service LP	Kennedy International (KIAC)	(718) 995-3736	Kennedy International Airport
Brooklyn Navy Yard Cogeneration Partners	Brooklyn Navy Yard	(718) 246-0887 (718) 246-0870	63 Flushing Ave #300, Brooklyn
Transcanada Ravenswood, LLC	Ravenswood 1	(718) 706-2874	Vernon Blvd and 38 th Avenue, Queens
	Ravenswood 2	(718) 706-2874	Vernon Blvd and 38 th Avenue, Queens
	Ravenswood 3	(718) 706-2876	Vernon Blvd and 38 th Avenue, Queens
	Ravenswood A House	(718) 706-2781	Vernon Blvd and 38 th Avenue, Queens
	Ravenswood Gas Turbines	(718) 389-2810 (718) 389-2640 (347) 386-0407	Vernon Blvd and 43rd Avenue, Queens
	Ravenswood 4	(718) 389-2810 (718) 389-2640 (347) 386-0407	Vernon Blvd and 37 th Avenue, Queens

Notes

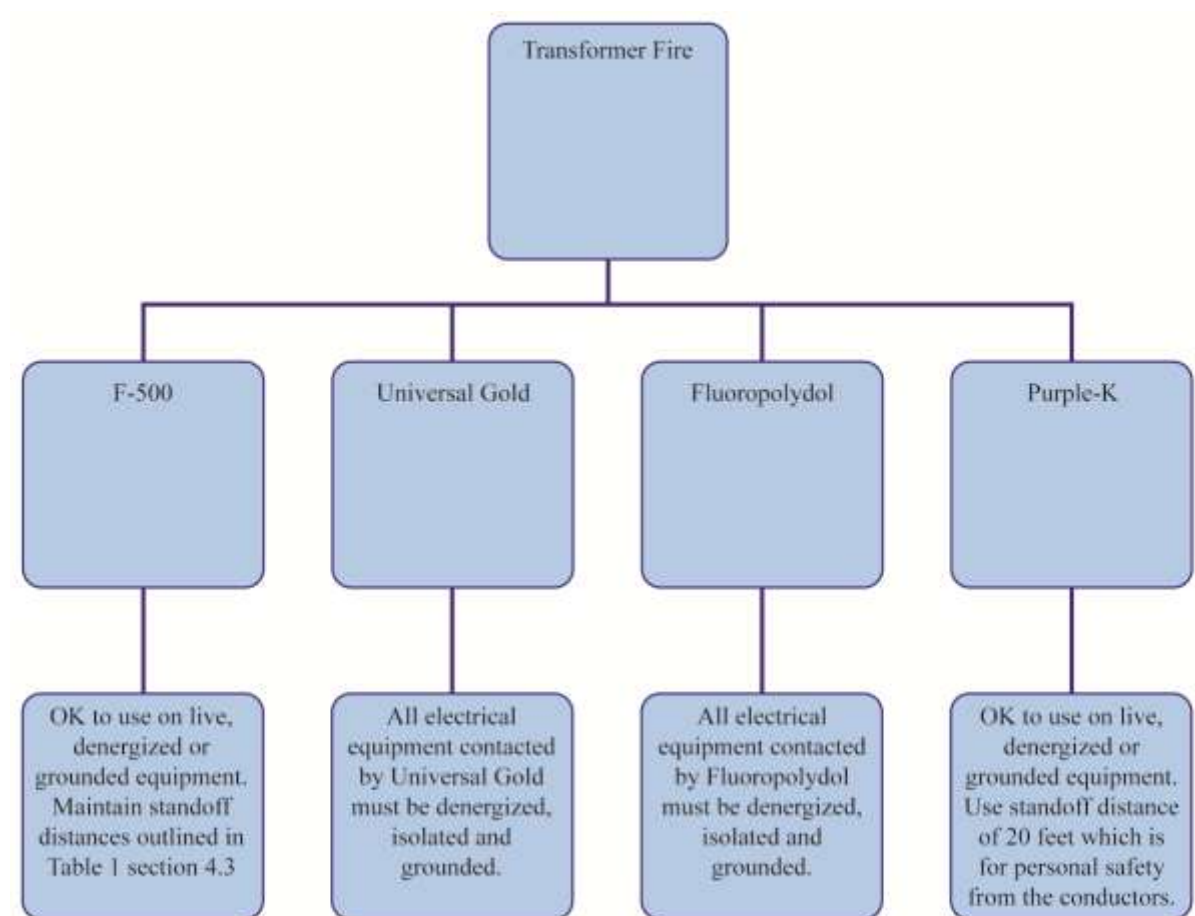


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Attachment 7.6 Decision Making Guide





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Attachment 7.7

Sustained Arcing
Normal Fire – Figure 1



Sustained Arcing – Figure 2

