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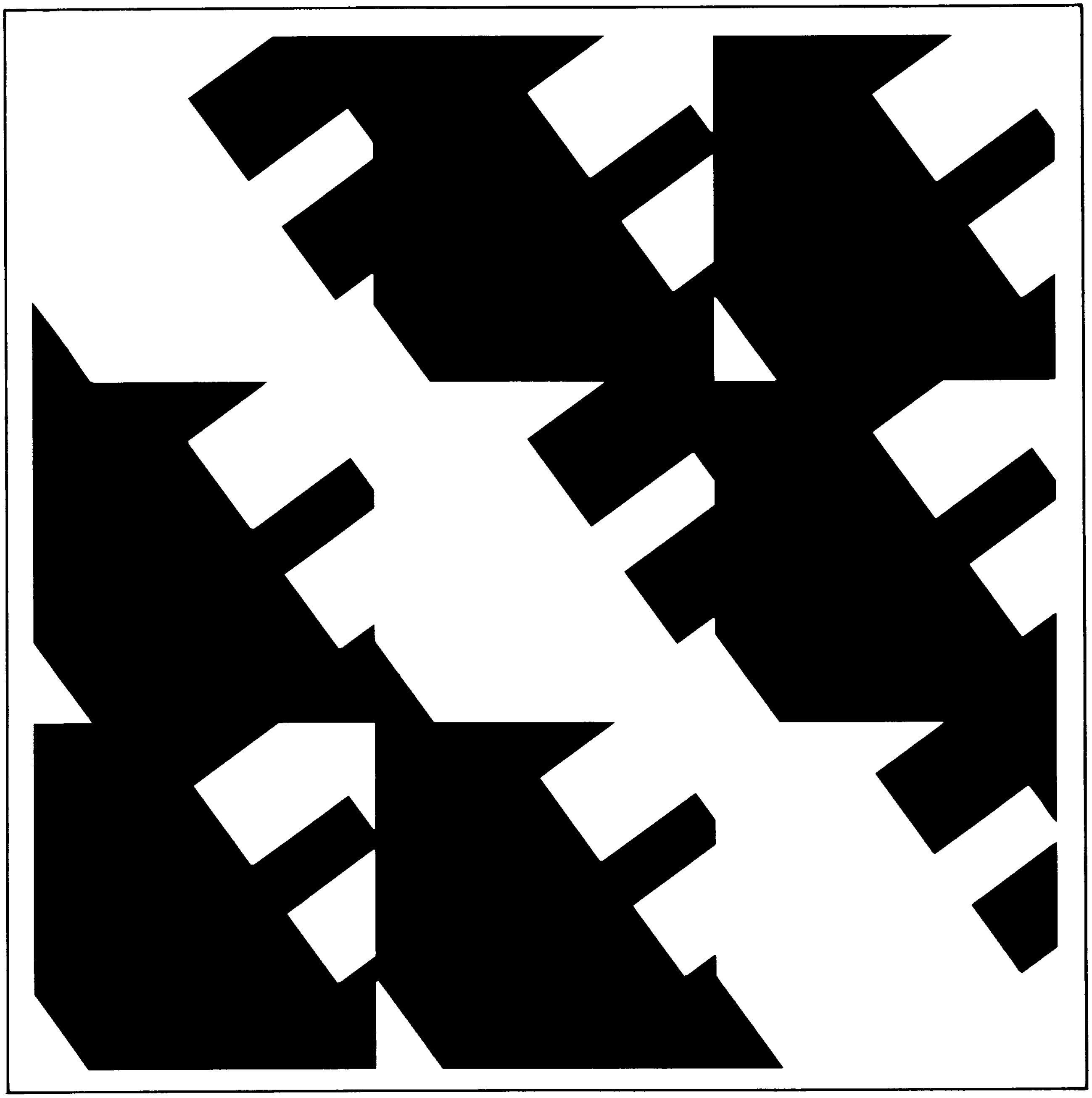
IEEE Guide for Containment and Control of Oil Spills in Substations



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of the
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Foreword

(This Foreword is not a part of ANSI/IEEE Std 980-1987, IEEE Guide for Containment and Control of Oil Spills in Substations.)

On December 31, 1973, the federal government published in its Code of Federal Regulations, under Title 40 — Protection of the Environment, the federal requirements for the preparation and implementation of Spill Prevention Control and Countermeasure (SPCC) plans applicable to the discharge of oil at electrical facilities. While these regulations, in the strictest sense, relate to oil spills into navigable waters from shore facilities, it should be realized that these regulations could very easily be, and in some states are, extended to cover onshore areas. Onshore areas could be a distance away from navigable waters and could include those areas where substations are installed.

It is prudent, therefore, to recognize that there exists a potential for oil spills in almost every substation throughout the utility industry. It is consequently reasonable to identify the extent of the problem, if any, and to recommend plausible measures to control oil spills by means of an IEEE guide.

This guide has been prepared by a task force appointed by Working Group 73.2, Design and Location of Substations for Community Acceptance, under the sponsorship of the Substation Environmental Subcommittee of the IEEE Substations Committee. The assistance of R. H. Bower, Chairman, and other members of the Substation Environmental Subcommittee, is gratefully acknowledged.

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1. Scope and References

1.1 Scope. This guide discusses the significance of federal oil spillage regulations and their applicability to substations; identifies the problem of oil spills, which is latent in all substation facilities; discusses the economic aspects of oil spill control; quantifies the extent of the problem with respect to probability of occurrence and degree of risk; discusses methods of dealing with the problem; and provides guidelines for managing the problem.

It is not the intent of this guide in any respect to interpret federal regulations. Such interpretation is left to each individual company. The guide is intended in simple, abbreviated form to identify the problem, offer solutions, and let each company make its own evaluation and decisions.

A complete treatise on the subject of oil spill control, containment, and cleanup is contained in US Department of Agriculture REA Bulletin 65-3 [5].[1]

This guide only applies to insulating oil containing less than 50 ppm of PCB, which is considered to be non-PCB oil. Non-PCB oils have a PCB content that has been designated by the EPA as non-hazardous to the public, and they are not deemed to be toxic substances. It should be understood that local and state regulations could be more restrictive.

PCB oils (above 500 ppm) and PCB-contaminated (50-500 ppm) oils come under the purview of Public Law 94-469, Toxic Substances Control Act*, and are beyond the scope of this guide.

[1] The numbers in square brackets correspond to those of the references listed in 1.2 of this standard.

*This federal law can be located in Volume 90 of the US Statutes, p. 2003.

1.2 References. This standard shall be used in conjunction with the following publications:

[1] Code of Federal Regulations, Title 40: Protection of the Environment (40CFR), Parts 109-112.[2]

[2] Connecticut General Statutes, Title 25, Section 54dd ET SEQ, Water Pollution Control.[3]

[3] Electric Power Research Institute, EPRI-FP-1207, 1979, Disposal of PCBs and PCB-Contaminated Materials.[4]

[4] Massachusetts General Law, Chapter 21, Section 27 ET SEQ, Division of Water Pollution Control.[5]

[5] United States Department of Agriculture, REA Bulletin 65-3, 1981, Design Guide for Oil Spill Prevention and Control at Substations.

2. Statutory Requirements

2.1 Federal. Complete information on the federal requirements for control of oil spills is contained in the Code of Federal Regulations, Title 40 (40CFR) [1], Chapter 1, Parts 110-112. Definitions and specifics regarding navigable waters are contained in this publication and it is not considered necessary to repeat the information in this guide.

[2] This document is available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

[3] This document is available from the Office of the Secretary of State, 30 Trinity Street, Hartford, CT 06106.

[4] This document is available from the Electric Power Research Institute, 3412 Hillview Avenue, PO Box 10412, Palo Alto, CA 94303.

[5] This document is available from Citizen's Information Services, Office of the Secretary of State, One Ashburton Place, Room 1611, Boston, MA 02108.

The regulations prohibit the discharge of oil into navigable waters of the USA, and through the implementation of a Spill Control and Countermeasure (SPCC) plan require that effective containment plans be made to prevent the discharge of oil, and specify that a cleanup procedure or contingency plan be established in the event of a discharge of oil. Cleanup procedures by themselves are only required if containment is shown to be not practical. It is important to note here that the Environmental Protection Agency (EPA) might interpret the term "not practical" to mean *not at all possible* as against a more reasonable interpretation of *not economically practical.* Furthermore, although federal and regional EPA agencies are in fundamental agreement, we should recognize the possibility of some degree of latitude in interpretation between federal and regional agencies and be guided accordingly.

These regulations apply to installations that have a capacity to contain oil stored underground in excess of 42 000 gal, or a capacity stored above ground in excess of 1320 gal per facility, or 660 gal per container. Such a prevention plan could include the use of dikes, berms, curbing, culverting, weirs, absorbent materials, sumps, and collection systems designed for the purpose of containing any discharge of oil. In short, this requirement specifies that a properly engineered plan should be developed and documented to contain the surface discharge of oil from any storage container at a facility that, due to its location, could reasonably be expected to discharge oil into or upon navigable waters in sufficient quantity to cause an oil sheen, or to clean up the spilled oil if containment can be shown to be not practicable. Furthermore, it is important to note that the EPA accepts a definition of navigable waters to include navigable waters, river systems, lakes and ponds, stream and river beds, and all wetlands. Again, this may be subject to EPA federal or regional interpretation differences.

In addition to the requirements prohibiting the discharge of oil, 40CFR [1] specifies that in the event of an oil spill of more than 1000 US gal in a single spill or two spills of harmful quantities from the same facility in any 12-month period, a report shall be made to the Environmental Protection Agency—Regional Administrator, within 60 days from the date of the spill. Such a report should contain the identification of the facility and information relating to the date and description of the spill, copy of the SPCC plan, cause, corrective action, and additional preventive measures that have been taken. Regulations require that any report of an oil spill be sent to the appropriate state agency as well.

In as much as the regulations make reference to an SPCC plan for a facility, it is the interpretation by the EPA that each facility (installation) should have its own plan. While an overall plan for substations could be generic in nature, it appears there is a requirement to site-specify the plan uniquely for each installation. Sufficient detail should be included in the overall plan to identify location of equipment, contour of site, and surrounding area and drainage pattern(s).

In summary, therefore, federal regulations require that each installation falling in the category of oil containment size identified above be assessed for possibility of contaminating navigable waters. If the potential for contamination exists, then an SPCC plan should be developed. Such a plan should contain all requirements of 40CFR [1], 112.7, including a contingency cleanup plan if containment is proven to be not practical.

2.2 State and Local. Information on state and local requirements regarding oil spills is contained in 40CFR [1], Part 109.

Some state governments have adopted the existing federal regulations prohibiting discharges of oil. Specifically, it is the responsibility of the state and local governments to enforce the cleanup portion of SPCC plans implemented by a utility within that government's jurisdiction. The procedure for the reporting of oil spills to state agencies varies from state to state, but generally, the procedure could be more stringent than that of the federal government. The procedure usually requires a report by telephone immediately following the spill and a follow-up written report that should include all the details of the oil spill. With respect to a cleanup plan, state agencies generally require that cleanup plans for oil spills be developed, written, and filed with the agency. Such a plan should contain a written commitment of manpower, equipment, and materials that would be required to expeditiously control and remove any quantity of spilled oil.

3. Typical Sources of Oil Spills

3.1 Transformers. Transformers (also oil-filled reactors) are the potential source of major oil spills in substations, since they typically contain the largest quantity of oil. Spills may be caused by an electrical failure, vandalism, sabotage, accident, or leaks.

Depending on its rating, a power transformer may contain anywhere from a few hundred gallons of oil up to 30 000 gal or more, with 2000 to 10 000 gal being typical. Substations usually have one to four power transformers but may have more. Substations have a very low turnover rate for oil, since transformers and other electrical equipment normally operate for many years before the oil is replaced or reconditioned.

3.2 Circuit Breakers. Circuit breakers rank second as a source of oil spills in substations. Similar to transformers, spills are caused by essentially the same types of incidents such as electrical failure, vandalism, sabotage, accident, or leaks.

The higher voltage oil circuit breakers usually have three independent tanks, each containing approximately 100 to 4000 gallons of oil, depending on their rating. Most of these tanks and most single tank circuit breakers contain less than 1200 gal of oil. Substations may have ten to twenty or more oil circuit breakers.

3.3 Cables. Substation pumping facilities that maintain oil pressure in pipe-type cable installations rank a distant third as source of oil spills. Again, spills are caused by electrical failure, vandalism, sabotage, accidents, or leaks.

Depending on its length and rating, a pipe-type cable system may contain anywhere from 1500 up to 10 000 gal or more of oil.

3.4 Mobile Transformers. Although mobile transformers are used infrequently, even rarely, the same considerations should be given to the quantity of oil and risk of oil spill that are given to permanent transformers.

3.5 Miscellaneous. Station service transformers, voltage regulators, oil circuit reclosers, and other pieces of electrical equipment contain small amounts of insulating oil; however, only under most unusual circumstances could they be responsible for an oil spill of the magnitude described in 40CFR [1].

4. Probability of Oil Spills

Both the frequency and magnitude of oil spills in substations can be considered to be extremely low. This is verified by the results of two questionnaires submitted in 1977 to utility members of the IEEE Substations Committee by the Oil Spill Prevention, Control and Countermeasures Task Force of the Environmental Subcommittee. A summary of these results, which reflects the number of spills over two separate time periods, is contained as Appendix D in this guide.

The Task Force concluded that, while this empirical data was not precise, it clearly indicated that the number of spills per piece of equipment in service per year is extremely small.

The probability of a reportable spill at any particular location depends on the quantity of oil present, number of oil containers, and other conditions peculiar to that location.

5. Warning Alarms

In the event of an oil spill, it is imperative that cleanup operations and procedures be initiated as soon as possible to reduce or prevent any discharged oil from reaching navigable waters as defined by regulation. Hence, it may be desirable to install an early detection system for alerting responsible personnel to an oil spill.

The most effective alarm would be that activated by a low oil-level indicator within major pieces of oil-filled equipment, but any of several different alarm systems may be used. The alarm should be transmitted to a manned station via supervisory equipment or via a remote alarms system to identify the specific problem. The appropriate personnel should then be informed and they, in turn, should proceed to investigate and implement the SPCC contingency plan.

6. Containment

In general, 40CFR [1], Chapter 1, Part 112, requires that appropriate oil containment and diversionary structures, or both, should be provided to prevent discharged oil from reaching navigable waters if a facility could reasonably be expected to discharge oil into or upon said navigable waters. Further, if it is determined that the installation of oil containment and/or diversionary structures, as listed in Part 112.7(c), is not practical (meaning that the measures are unsuitable for use at the facility), the owner or operator should clearly demonstrate such impracticability and subsequently proceed to prepare a written oil spill contingency plan (see Appendix A, SPCC contingency plan) which commits manpower, equipment and materials to control and remove any quantity of discharged oil. Section 7 of this guide discusses cleanup procedures and makes reference to a sample SPCC contingency plan.

As pointed out in Section 4, the probability of an oil spill occurring in a substation is extremely low. However, certain substations, owing to their proximity to navigable waters or designated wetlands, the quantity of oil on site, surrounding topography, soil characteristics, etc, have or will have a higher potential for discharging harmful quantitites of oil into or upon navigable waters or wetlands. Installation of oil containment facilities should be considered at these locations.

It is beyond the scope of this guide to make specific recommendations as to which type of oil containment system is best suited for specific incidences due to the wide range of site variables that can exist. However, as an aid to those engaged in the design of oil containment facilities, several examples of various types of systems that can be utilized are listed for reference in Appendix B.

Figure B1 illustrates a typical open oil-containment retention pit facility into which a pipe drainage system empties. The drainage system network connects numerous stone-filled collecting pits located under various oil-filled pieces of equipment, and directs surface water run-off and any potential oil spill to the retention pit.

Figure B2 is basically the same as Fig B1, except the retention pit has been replaced with an oil trap structure that requires less land area. Therefore, this type of installation may be more practical at substations where available land area is constrictive. The design of this oil trap, like that of the retention pit, is based on the difference in specific gravity between water and oil. Unlike the retention pit system, which is designed to contain the entire quantity of discharged oil plus an assumed amount of retained water, the oil trap is constructed such that any discharged oil is backed up through the drainage system and contained in the various collecting pits beneath oil-filled equipment.

Figure B3 shows the detail of the gravity separator that is designed to allow storm water to discharge from the retention pit while at the same time containing spilled oil.

Figure B4 is similar to Fig B3, except that while Fig B3 would suit the normal installation, Fig B4 is designed for those areas of below-freezing temperatures for extended periods of time. Depth of discharge pipe would be determined relative to the average penetration of frost for the specific area of installation and would be a matter of judgment by the utility.

Figure B5 is another example of a simple, inexpensive water separator unit that could be effective in draining water from an oil sump.

Figure B6 is a typical cross-section of the retention pond system and illustrates the design principle upon which this system is based. Oil, being less dense than water, will float on top of the water and is effectively contained on site by proper sizing of the pond and the design of the gravity separator. Generally the pond is sized such that it will contain the entire quantity of discharged oil from the largest piece of equipment plus an assumed amount of retained water (see 6.2 for a discussion of oil volume requirements). Substation sites located in areas of porous soil, where the permeability is approximately 10^{-1} to 10^{-3} cm/s (see 6.1), should have their oil-collecting pits and retention ponds sealed (with concrete, or a clay layer, or plastic or rubber pit liners, etc) to prevent migration of oil into the ground.

Figure B7 illustrates, in cross-section, the oil trap and drainage system. In order for this system to function properly, a water level must be maintained in the manhole portion of the oil trap at an elevation no lower than 2 ft below the inlet elevation. This will ensure that an adequate amount of water is available to develop the necessary hydraulic head within the inner (smaller) vertical pipe, thereby preventing any discharged oil from leaving the site.

Figure B8 is a typical detail of an oil trap structure and clearly shows both water head and oil head. It is important to note that the inner vertical pipe should be extended downward past the calculated water-oil interface elevation sufficiently to ensure that oil cannot discharge upward through the inner pipe. Likewise, the inner pipe must extend higher than the calculated oil level elevation in the manhole to ensure that oil does not drain downward into the inner pipe through the vented plug. The reason for venting the top plug is to maintain atmospheric pressure within the vertical pipe, thereby preventing any possible siphon effect.

The above oil-containment facilities are designed to fully contain any discharged oil on site. These systems could generally be installed without too much difficulty during construction of new substations, but may be rather impractical to install at existing substations. If it is determined that a complete oil-containment system is impractical to construct, in which case an SPCC contingency plan is required, a designer should utilize a partial containment system to act as a delaying mechanism by impeding the flow of oil. This will provide extra time for cleanup operations. The use of strategically located berms or dikes constructed of low permeability soil is an example of a partial containment system.

The above facilities assume the spilled oil to exist in bulk form or to be floating in bulk form on whatever residual water is present in the pit. Where fire protection sprays are used by some utilities to extinguish a transformer fire, the oil can become emulsified to some degree and could be discharged through a gravity separator arrangement. This might necessitate that the containment pit be sized to contain oil and fire suppression spray liquid before discharge is permitted.

6.1 Soil Characteristics. Unlike other common engineering materials (such as wood, steel and concrete), a soil is largely a non-homogeneous mass possessing a wide range of physical properties. Of these properties, the soil's drainage characteristic is of primary concern in the design of oil containment facilities and is termed permeability. Permeability is a property of soil that denotes its capacity to conduct or discharge fluids under a given hydraulic gradient. Coarse-grained soils are considered highly pervious and have corresponding high permeability coefficients while fine-grained soils have low permeability coefficients. In other words, all other things being equal, the higher the coefficient of permeability, the faster a fluid will drain through the soil.

For the purposes of this guide, soils and their permeability characteristics have been adapted from typical references and can be generalized as follows:

Permeability (cm/s)	Degree of Permeability	Types of Soil
Over 10^{-1}	High	Stone, gravel and coarse to medium-grained sand
10^{-1} to 10^{-3}	Medium	Medium sand to uniform, fine sand
10^{-3} to 10^{-6}	Low	Uniform, fine sand to silty sand to sandy clay
Less than 10^{-6}	Practically impermeable	Sandy or silty clay to clay

In designing an oil-containment system capable of retaining any discharged oil on site for an extended period of time, consideration should be given to sealing any collecting pit or retention pond (containment pit), as shown in Appendix B, Figs B1—B10, constructed in soils of medium to high permeability if migration of spilled oil into underlying soil layers is to be prevented. The application of a lining of low permeability soil to a collection pit or retention pond is a reasonable means of slowing oil movement and enhancing containment.

6.2 Volume Requirements. Before an oil containment facility can be designed, the designer should know the quantity or volume of oil to be contained by the facility. As previously discussed, the probability of an oil spill occurring at a substation is very low. Therefore, it would be unreasonable and very expensive to design a containment system to hold the sum total of oil contained in the numerous oil-filled pieces of equipment normally installed in a substation. Section 3.1 of this guide identifies that power transformers are the potential source of major oil spills due to the large volume of oil they contain. In general, an oil containment system should be sized to contain the volume of oil in the single largest oil-filled piece of equipment, such as a power transformer or large circuit breaker. Due consideration should be given to the fact that a larger piece of equipment may be placed in service at some future date.

In cases where oil collecting pits are sized to contain the oil (Fig B7, for example), consideration should also be given to the size of stone used as backfill material and its corresponding porosity. Depending on the uniformity of stone size used, the porosity may vary from 20% to 50%. The size of stone has little to do with the volume of voids. In general, the smaller the particles, the greater the volume of voids. However, permeability decreases with decrease in particle size, making larger stones more suited for oil containment areas. Of fundamental importance, though, is the need to use uniform stone size. While it is possible to attain a porosity of 50%, a design figure of 35% is recommended.

As an illustration, assume a collecting pit is backfilled with large stones (assume 1.5 in trap rock providing 35% porosity) and must be designed to contain 8000 gal of oil. Due to the available voids, the pit would have to be physically sized, conservatively, to contain 23 000 gal of oil. This would contain the oil and provide some allowance for precipitation, even if automatically drained.

6.3 Fire Considerations. One other important point that should be noted is that in designing (sizing) a stone-filled collection pit, the final oil level elevation should be situated approximately 12 in below the top elevation of the stone. This provides a fire extinguishing capability designed to quench flames in the event that a piece of oil-filled equipment catches on fire. The use of 1.5 in or larger stone (washed and uniformly sized) is recommended to permit quicker penetration to avoid a pool fire. Quenching pits are the most effective passive fire protection measure. See Figs B9 and B10 for examples of effective fire quenching pits.

7. Cleanup Procedures

A cleanup program is one of the most important aspects of an SPCC plan for substations and is required where containment is not practicable. In general, the procedures should address the following issues:

(1) Responsible or accountable manager(s) who will act as emergency coordinator

(2) Notification or reporting channels, or both, and requirements

(3) Supervisory responsibilities

(4) Employee assignments

(5) Methods of containment

(6) Site-specific instructions

(7) Training program(s) in cleanup procedures and spill prevention

(8) System for updating the procedures

(9) Location of special tools, equipment, and material

(10) Availability of contractors with cleanup expertise

The goal of any cleanup procedure is the protection of the environment against contamination. Prompt action is required whenever a spill has occurred. It is therefore most important that all personnel involved with substation operations or maintenance be instructed in prompt notification procedures. All substation personnel shall be instructed in steps that must be taken immediately to stop the source of the spill and other emergency measures that can be undertaken to prevent or control any discharge from the station. Typical cleanup methods are shown in Appendix C.

Cleanup procedures should outline the location and availability of the tools that are available for spill control. Equipment that may be needed includes: pumps, bulldozers, trenching machinery, miscellaneous hand tools, oil tanks and drums, timbers, pipe, hoses, burlap bags, sand, straw, oil absorbent materials, oil booms, boats, stakes, and fencing.

The procedures should describe methods of containing and cleaning up oil spills, such as skimming, boom construction and deployment, use of special oil-absorbent materials, use of machinery or special tools, or all of these. Appendix C provides some examples of these procedures.

8. Economic Aspects

This section provides a guide to the probable costs of oil spill prevention measures taken by a utility at substation facilities. This section also provides cost guidelines for cleanup procedures in the event that prevention measures are either absent or have failed. All costs are area-specific for the New England area and may vary for other locales.

8.1 Typical Prevention Costs (1983 Dollars)

Open Oil Containment Retention Pond (Fig B1 — Complete Drainage and Collection System, as Shown)	$33 400.00
Oil Trap Structure System (Fig B2)	$36 000.00

8.2 Typical Cleanup Costs (1983 Dollars)

Four-man Crew (to handle oil and soil)	$650.00 per diem
Oil Pumping Equipment	$1000.00 per diem
Removal Equipment (Oil)	$500.00 per diem
Removal Equipment (Soil)	$500.00 per diem
Cartage of Contaminated Soil (Barrels) (includes landfill burial)	$50.00 per barrel plus $3.00/mi travel

8.3 Typical Disposal Costs (per barrel in 1983 Dollars)

Utility Owned Incinerator*	$6.40/barrel credit
Commercially Owned Incinerator*	$95.00/barrel cost

*Must add $3.00/mi transportation cost

Costs may vary depending upon availability of disposal means and distance to established incinerator or landfill facilities.

NOTE: While present regulations permit incinerating waste oil in a utility boiler for heat recovery purposes, this could easily change if waste oil was designated as hazardous waste under the Resource Conservation and Recovery Act (RCRA). Utility companies that incinerate oil should be aware of this possibility since any change would probably restrict their incineration program. Furthermore, specific states might either prohibit burning entirely or require special air quality permits for burning.

Appendixes

(These Appendixes are not a part of ANSI/IEEE Std 980-1987, IEEE Guide for Containment and Control of Oil Spills in Substations, but are included for information only.)

Appendix A

Typical SPCC Contingency Plan Requirements

A1. Introduction

While an SPCC plan as detailed in 40CFR [1], Part 112.7, focuses on containment of oil and requires specific information about past oil spills, location of equipment, sources of potential spills, quantities of oil that could be discharged, drainage pattern, rate of flow, and containment measures, one of the important requirements of the SPCC plan is the contingency plan for cleanup if containment is proven to be impractical.

Facilities covered by this plan are electrical transmission and distribution substations as well as oil storage facilities associated with substations that have a single tank larger than 660 gal, or a total aggregate oil storage greater than 1320 gal, or both.

It can be assumed that oil discharge from facilities will be rare. However, should an oil spill occur, procedures outlined in this plan should be activated.

Sections A2-A5 are recommended as a basis for a contingency plan.

A2. Categories

For the purposes of this plan, all locations are classified under the following two categories:

Category A. Substations or facilities where, due to their location, or quantitites of oil involved, it is unreasonable to expect that any oil spill would result in a discharge into navigable waters as defined in 40CFR [1], Part 112.1(d)(4). A general plan applicable to all facilities in this category follows.

Category B. Substations and facilities where, due to their location, or quantities of oil involved, it is possible, but not probable, for an oil spill to reach navigable waters. A specific plan for each location in this category has been prepared. The general SPCC plan below also applies to these facilities.

Copies of the general plan and each specific plan should be on file at the associated division headquarters and at each covered facility. Copies of all plans should be on file at engineering, corporate headquarters, etc.

A3. Oil Spill Detection

Any appreciable discharge of oil from transformers, circuit breakers or other electrical equipment is a possible result of electrical failure of that equipment. These types of failures can be detected by alarms either directly from attended substations or transmitted by supervisory equipment, or by customer calls to dispatching centers as a result of equipment outage.

Slow leaks from electrical equipment or oil storage facilities will be detected and corrected during periodic and routine inspections.

A4. Reporting Procedure

It is the responsibility of any utility employee visiting one of the utility's facilities to immediately report an oil spill to the local operating supervision via telephone or company radio.

Local operating supervision should contact the designated representative, who will serve as director of control and cleanup operations.

The designated representative should contact the responsible person in engineering or maintenance to assist with operations and contact local managers, as necessary, and the appropriate governmental agencies, as required.

Responsible environmental personnel should report to the U.S. Regional EPA Office and other local, state or federal agencies as required any spill where there is a good probability that oil will reach water or which can be classified as a "spill event." A "spill event" is a discharge of oil to nearby navigable waters in harmful quantities, which

(1) violates applicable water quality standards of 15 ppm oil, or

(2) causes a film or sheen on the surface of the water or sludge emulsion beneath the surface.

See A6 for a typical notification form. A list of operating division personnel and engineering personnel to be contacted should also be included as an attachment to a cleanup plan.

A5. Action to Be Taken in the Event of an Oil Spill

Any employee who notes an oil spill on company property should promptly assess the situation within the limits of his training and experience. Specific actions required include:

(1) Determine source of spill.

(2) Take action to stop source of spill. For example, close necessary valves or temporarily plug holes to stop or control spill.

(3) Determine approximate size of spill in gallons and direction of flow.

(4) Report to local operating supervision in the appropriate division, who should notify the designated representative.

The designated representative should assess and arrange for materials and manpower, using his own work forces, other utility personnel, or outside contractors as required. Specific actions to be taken to contain a spill include:

(1) Containment of oil spill by blocking flow to drains and waterways by digging diversion ditches, sandbagging, or through other means.

(2) Blocking oil that has reached a waterway from spreading downstream by using booms or other means.

(3) Cleaning up oil by using absorbent materials, pumping and removing oil-saturated earth or stone, as required.

(4) For an oil spill reaching a public road, notify state or local police. For a spill consisting of highly flammable liquid such as gasoline, notify

Oil spill cleanup material should be provided at all regional service center location storerooms or crew quarters, or both. Materials available, and their respective catalog numbers, should be listed as an attachment. For selected locations under Category B (see A2), specific materials are located on-site to facilitate appropriate action to minimize effects of a spill.

For large spills, an outside contractor specializing in cleanup operations may be called in. Available qualified contractors for minor spills as well as qualified contractors for major spills should be shown as an attachment to the cleanup plan.

A6. Typical Notification Form

Date ____________________

(1) Name of Company ____________________

(2) Date of Spill ____________________

(3) Time of Spill ____________________

(4) Location of Spill ____________________

(5) Name of Receiving Body of Water ____________________

(6) Amount and Material Spilled ____________________ Gals of ____________________

(7) Probable Source ____________________

(8) Actions Initiated to Contain or Clean Up:

____

____

____

____

(9) Person to Contact on Scene:

Name ____________________

Phone ____________________

(10) Report Initiated By:

Name ____________________

Title ____________________

Phone ____________________

(11) EPA Person Notified:

Name ____________________ Date __________ Time __________

Title ____________________

Phone ____________________

Appendix B

Typical Containment Systems

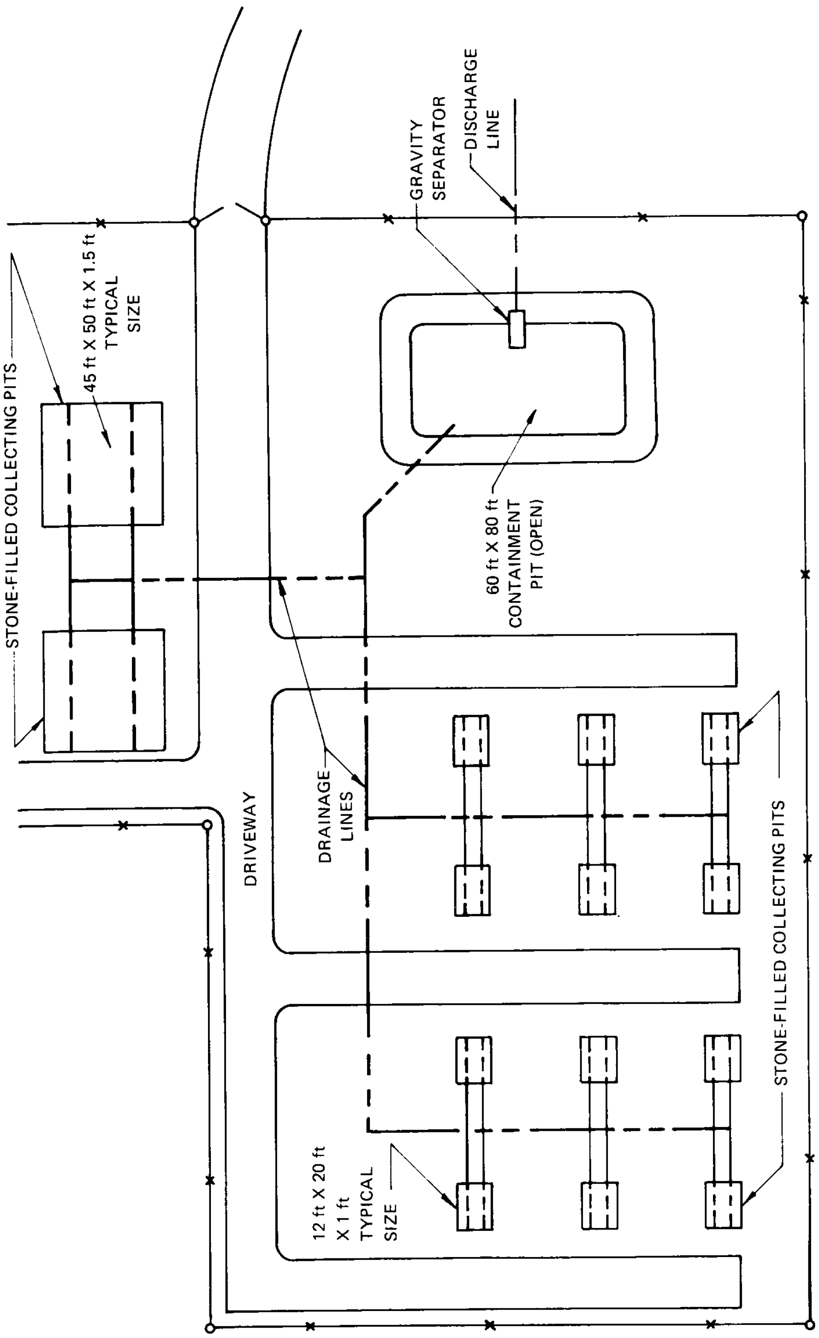


Fig B1
Typical Oil Drainage System with Oil-Containment Retention Pit

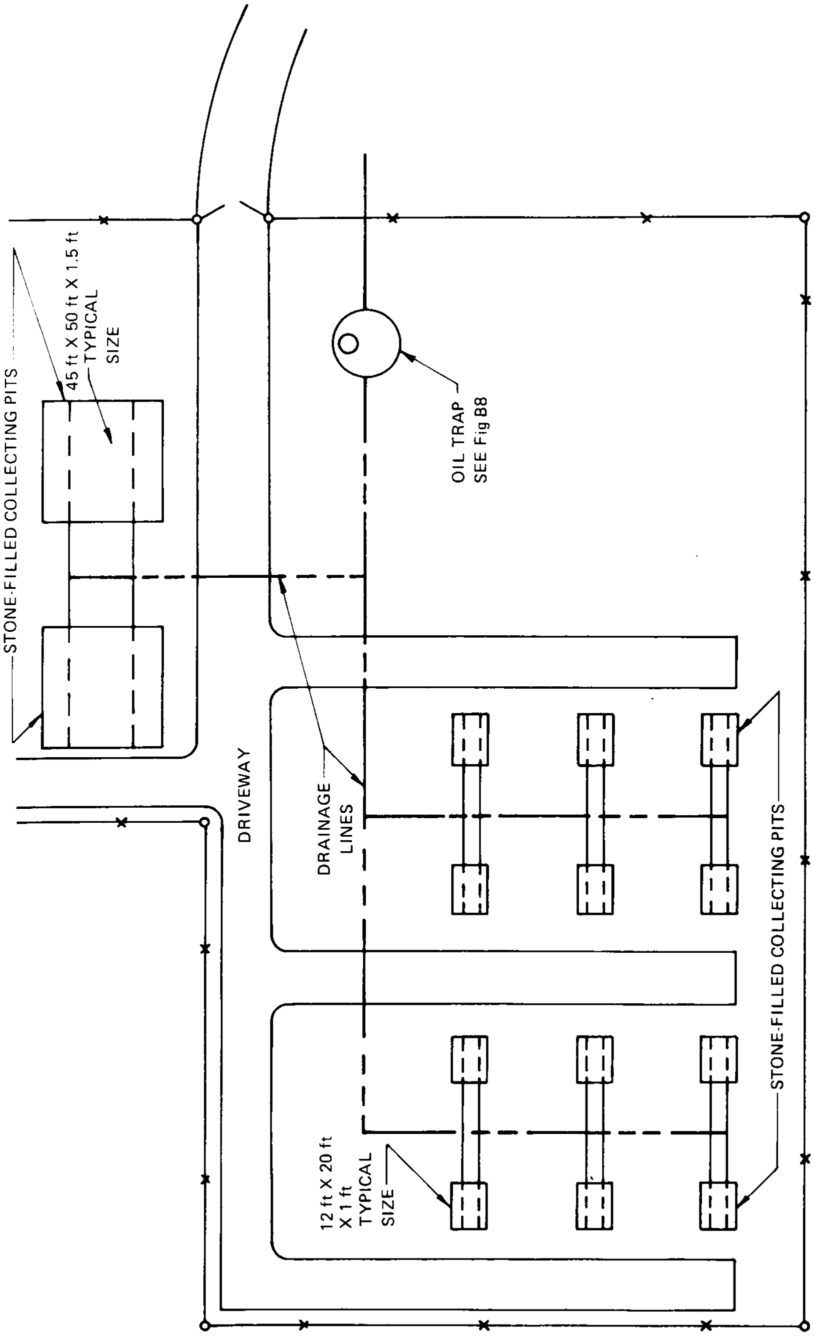


Fig B2
Typical Oil Drainage System with Oil Trap Structure

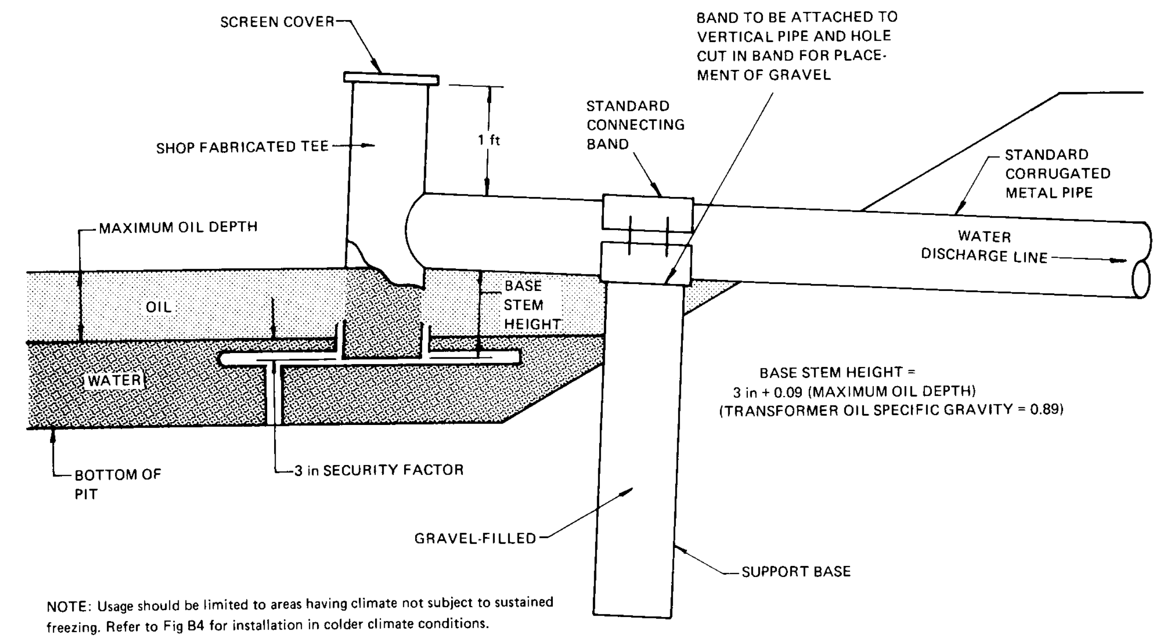


Fig B3
Gravity Separator

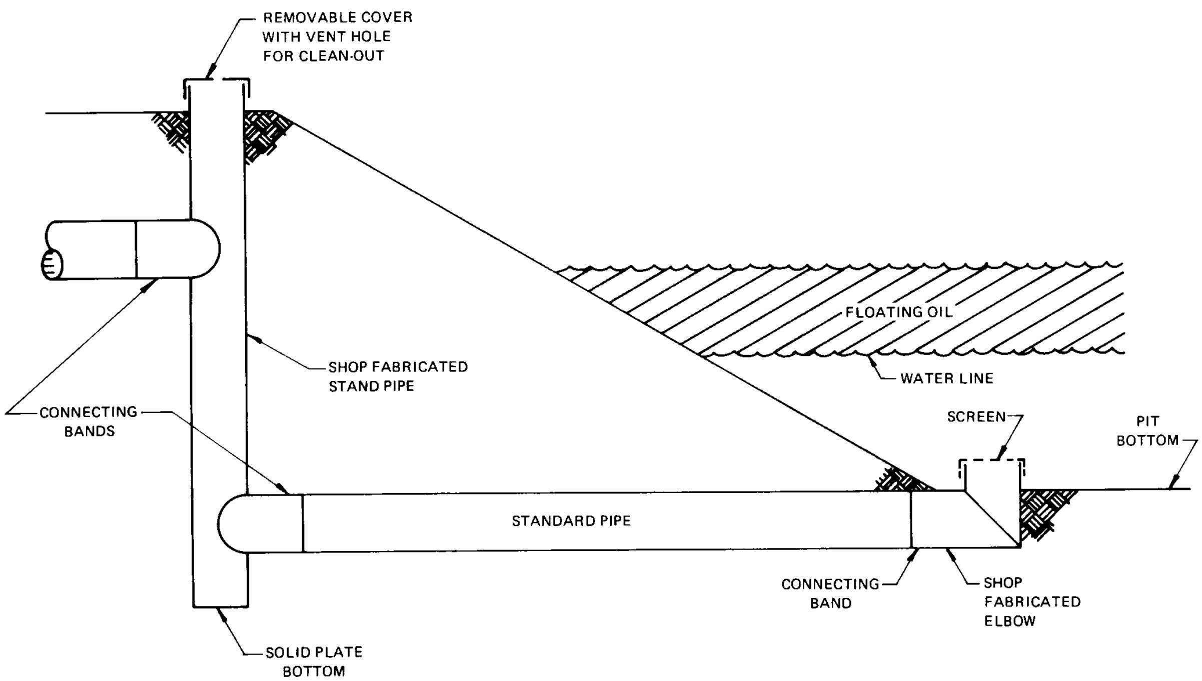


Fig B4
Drain Pipe Structure

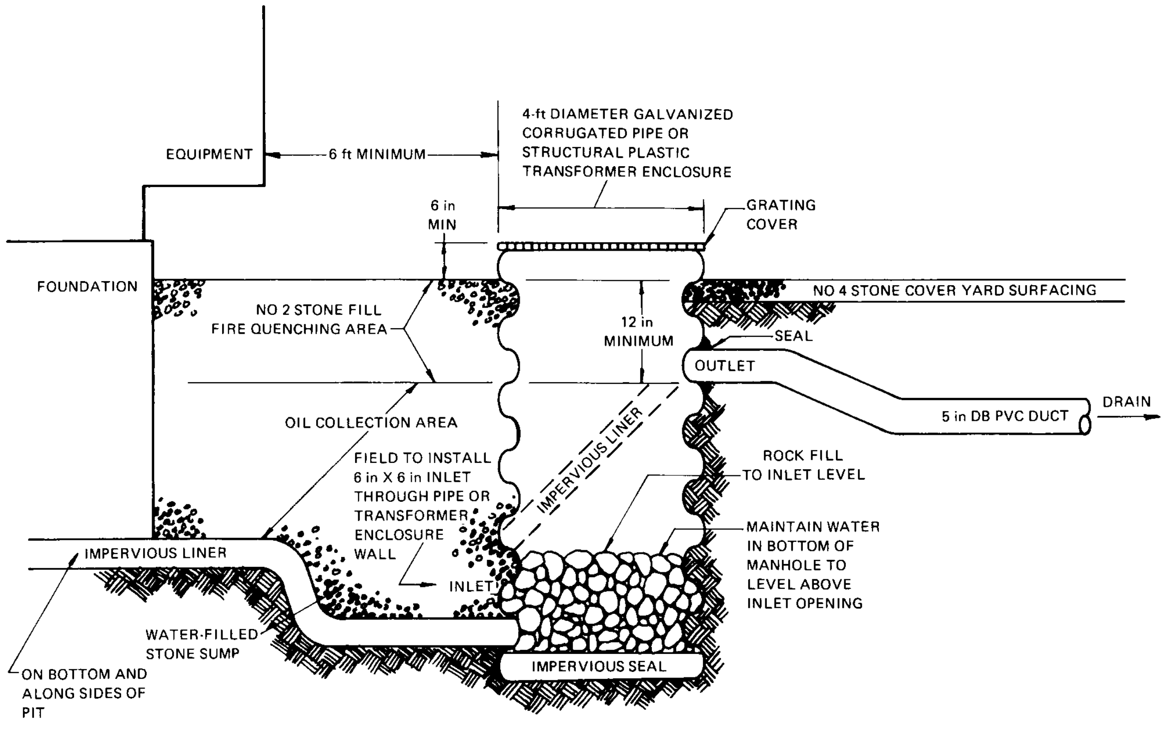


Fig B5
Simple Oil-Water Separator

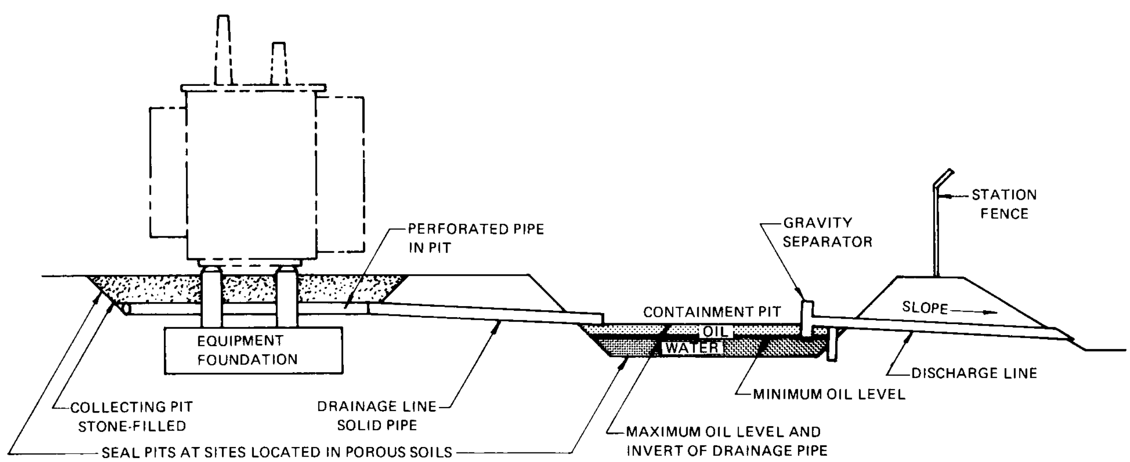


Fig B6
Cross-Section of Oil Drainage System with Oil-Retention Pond

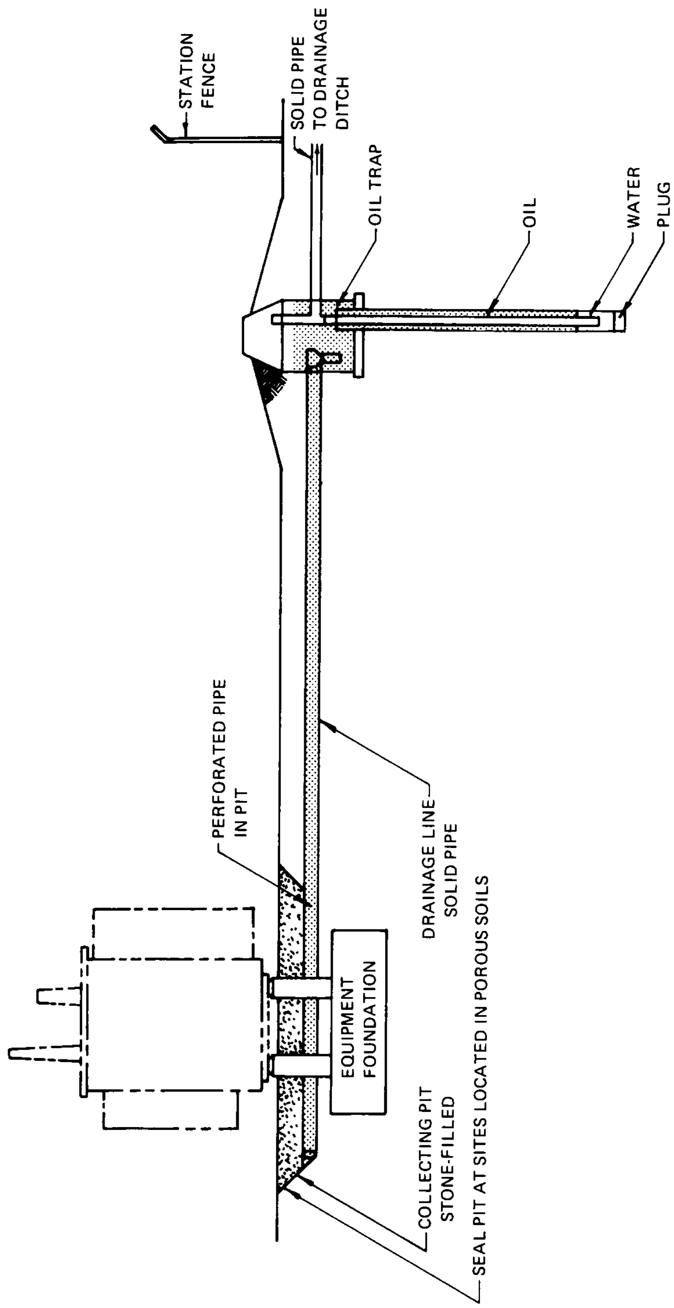


Fig B7
Cross-Section of Oil Drainage System with Oil Trap

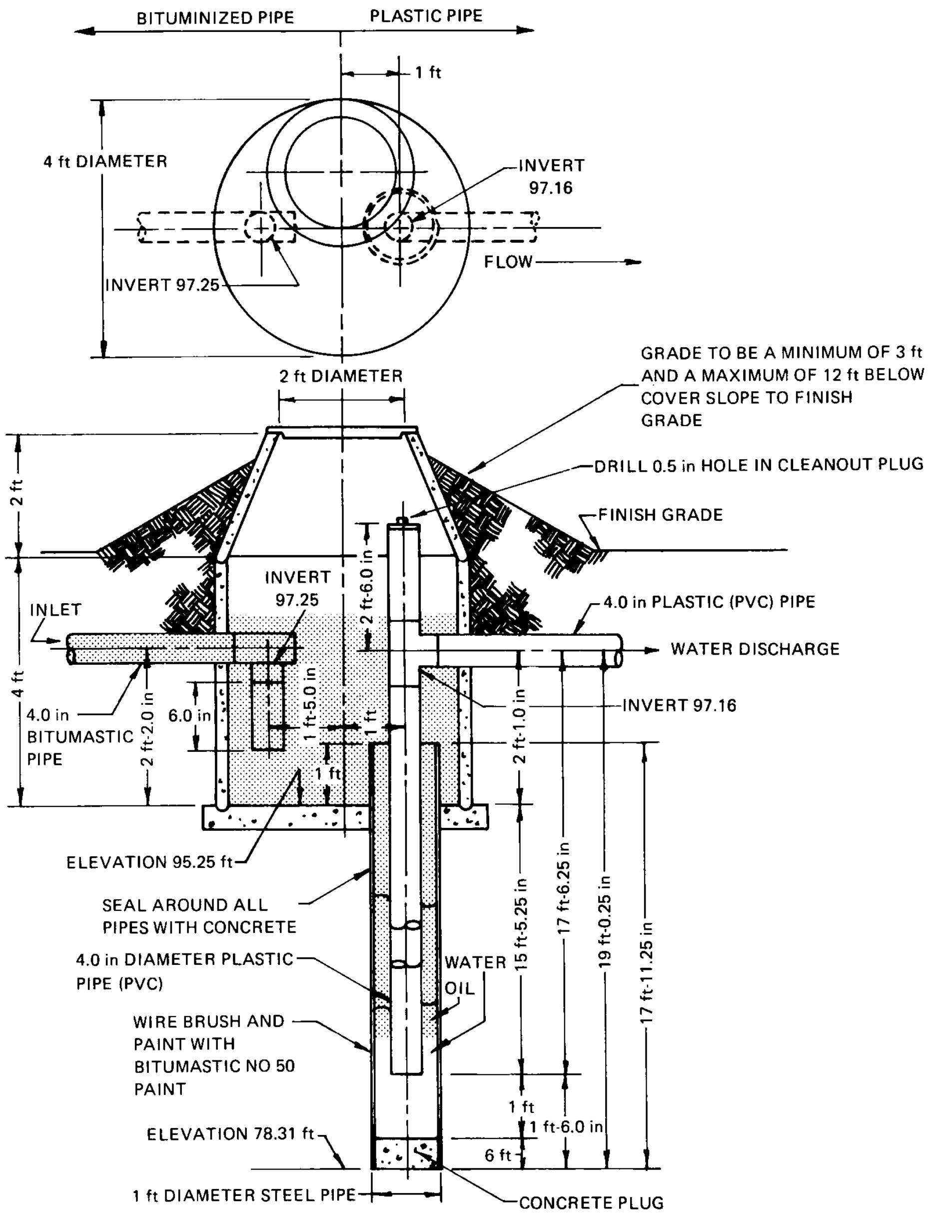


Fig B8
Oil Trap

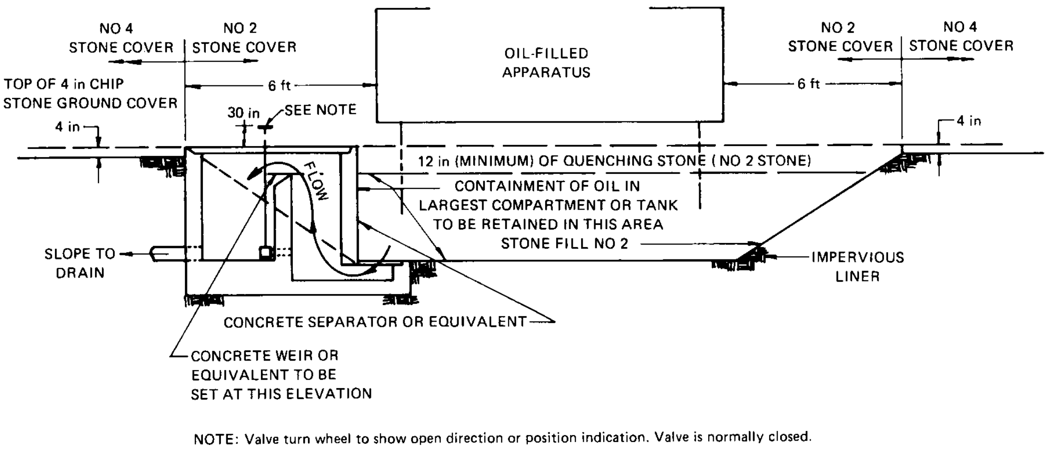


Fig B9
Typical Fire Quenching and Oil Retention Pit
(Not to Scale)

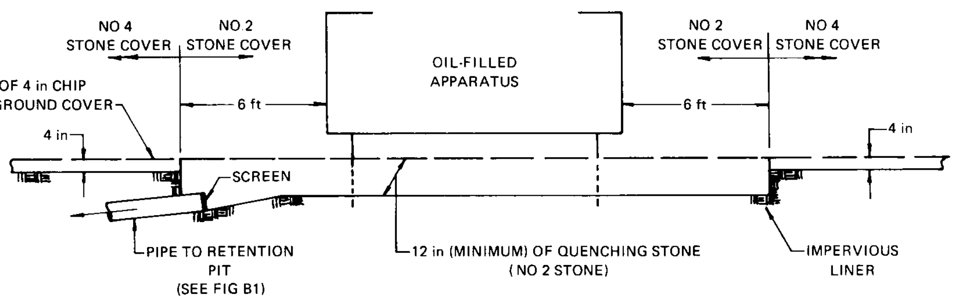
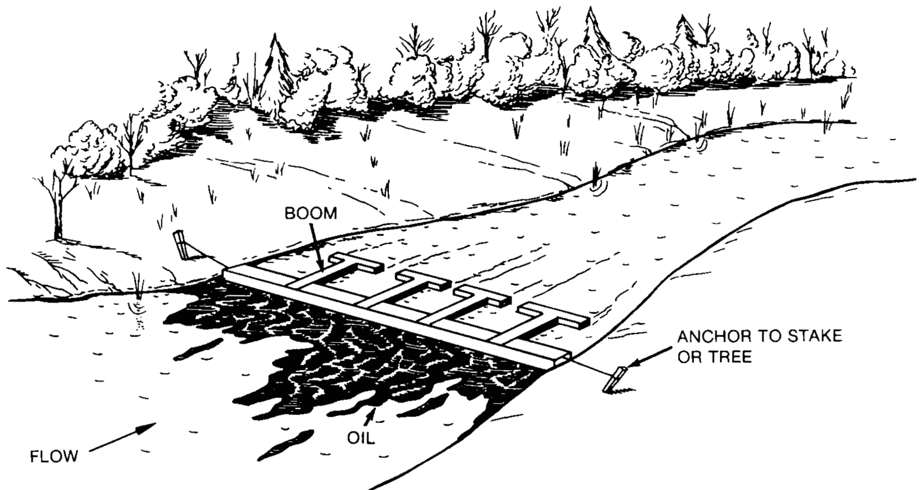


Fig B10
Typical Fire Quenching Pit
(Not to Scale)

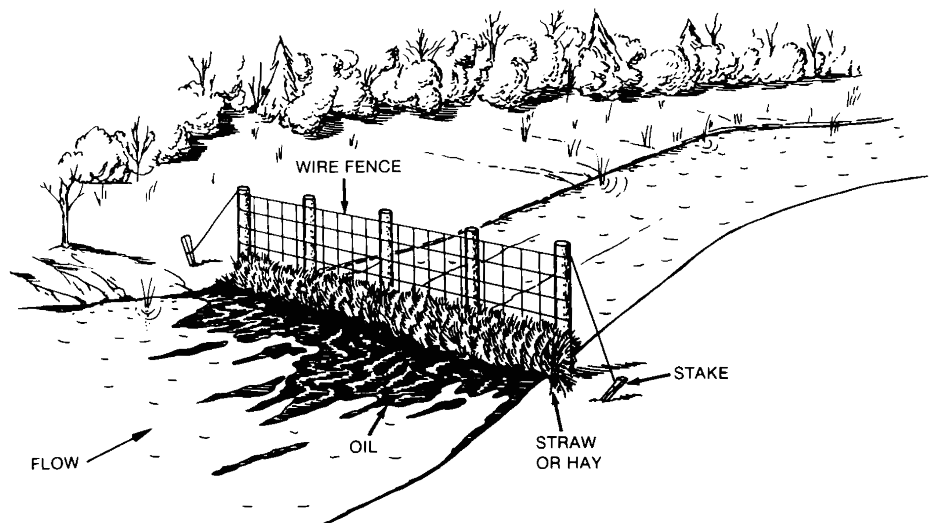
Appendix C

Typical Cleanup Methods



NOTE: In some cases, when sheet metal or plank facing is used it is necessary to take measures to prevent deflector from rolling. 2" x 4"s or poles fastened on top of deflector act as counter balance. This type of deflector must be securely anchored.

Fig C1
Boom Deflector



NOTE: Stretch wire fence across stream and anchor securely. Straw is placed on upstream side of fence. This type of installation should be used in a location where the stream banks are of sufficient height and movement of water is relatively slow.

Fig C2
Straw Skimming Installation

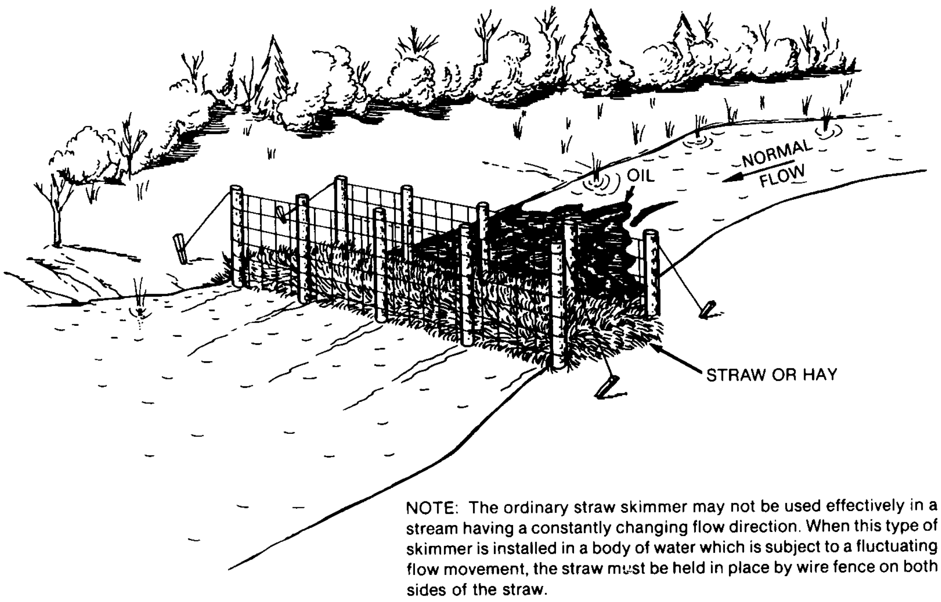


Fig C3
Straw Skimmer for Fluctuating Stream Flow

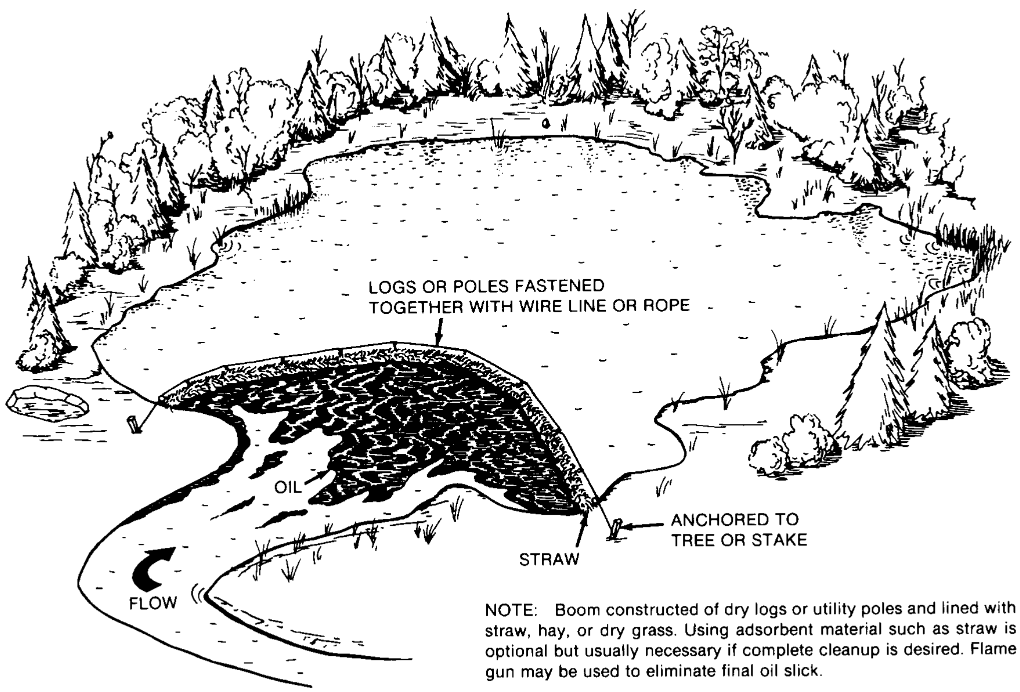
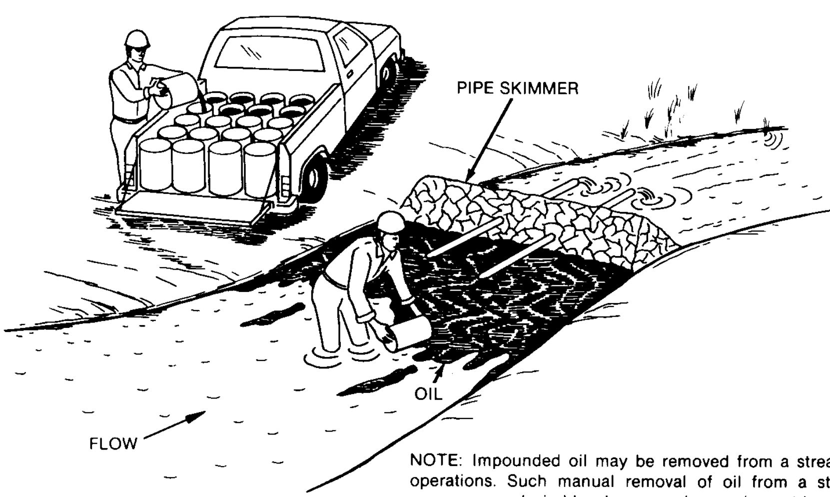


Fig C4
Oil Loss in Lake

NOTE: The final traces of an oil loss may be removed by covering the affected area with a coating of sand. Heavy sanding is recommended as a means of controlling the surface movement of oil from an oil-saturated area in close proximity to a stream. No attempt should be made to eliminate oil by sanding alone when a large amount of free oil is in evidence on the surface of the ground.

Fig C5
Covering Oil by Sanding



NOTE: Impounded oil may be removed from a stream by dipping operations. Such manual removal of oil from a stream may be necessary or desirable when pumping equipment is not available or when burning of the oil will destroy or endanger forest growth. The oil thus removed may be deposited in drums and trucked away from the vicinity of the stream to be salvaged or burned in a safe location.

Fig C6
Use of Oil Drums

Appendix D

Spill Probability Summary

D1. Results of Second Questionnaire on Oil Spill Prevention, Control, and Countermeasures

After the Task Force on Oil Spill Prevention Control and Countermeasures sent out a questionnaire in October 1976, the results were distributed in March 1977. From these results some further questions were raised, such as how does the number of spills compare to the number of pieces of equipment in service, and what were the causes of these spills? Answers to these questions should shed some light on the seriousness of the oil spill problem, since a spill caused by accident or negligence will most likely occur when personnel are present, and a leak will probably be a small amount discharged over a period of time, etc. To get these answers, a supplemental questionnaire was sent out in July 1977.

The original questionnaire was answered by 49 companies. Of these, 45 indicated that they had at least some records of their spills (a response other than "unknown"). The supplemental questionnaire was sent to these 45 companies. We have responses from 28 of them.

Please note that no attempt was made to edit the responses. They have been tabulated exactly as received although they contain such obvious errors as the sum of the various categories does not equal the total given, etc.

Following are tabulations of the results of the supplemental questionnaire providing the number of pieces of equipment in service and a second tabulation that shows the number of spills that these companies originally reported. In order to provide a common basis to calculate the ratio of number of spills per piece of equipment in service, only the responses of the 28 companies responding to both questionnaires have been used.

Using the figures obtained, these ratios are:

1965-1974

$$\frac{110}{36\,925} \cdot 100\% = 0.3\%$$

1975-1976

$$\frac{33}{39\,835} \cdot 100\% = 0.08\%$$

The information shows that during the ten-year period from 1965-1974, these companies had a total of less than one discharge for each 330 pieces of equipment in service. Over the two-year period 1975-1976, these companies had less than one discharge for each 1200 pieces of equipment in service.

Another ratio that can be obtained from this data is the number of oil discharges that reached surface waterways per piece of equipment installed.

These ratios are:

1965-1974

$$\frac{7}{36\,925} \cdot 100\% = 0.02\%$$

1975-1976

$$\frac{6}{39\,835} \cdot 100\% = 0.015\%$$

These figures show that during the ten-year period, these companies had a total of less than one discharge that reached a waterway for each 5275 pieces of equipment in service. During the two-year period 1975-1976, these companies had a total of less than one discharge into a waterway for each 6640 pieces of equipment.

Therefore, from this data we have found that the number of spills per piece of equipment in service per year is extremely small, and does not provide significant justification for expensive oil containment measures.

D2. History of Oil Spills (Original Questionnaire)

	1965-1974	1975-1976
(1) How many oil discharges did you have?	60	33
(2) How many oil discharges left substation property?	7	7
(3) How many oil discharges reached surface waterways?	7	6
(4) How many oil discharges reportedly reached ground water?	3	3
(5) How large were the discharges from transformers? (with 660 gal/tank)		
(a) 10-100 gal	18	11
(b) 101-1000 gal	20	18
(c) 1001-2500 gal	6	2
(d) 2501-5000 gal	4	1
(e) Larger—How much?	3	1
(6) How large were the discharges from oil circuit breakers? (with 660 gal/tank)		
(a) 10-100 gal	6	—
(b) 101-1000 gal	5	—
(c) 1001-2500 gal	1	—
(d) Larger—How much?	—	—

D3. Summary of Supplemental Questionnaire Responses

		1965-1974	1975-1976
(1) What was the average number of pieces of equipment in service (with 660 gal/tank)?			
Transformers (Trans)		26 223+	28 031+
Oil Circuit Breakers (OCB)		10 702+	11 804+
(The best approximation readily available)			
Total:		36 925+	39 835+
(2) How many of the oil spills you reported were caused by:			
Failure	Trans	23	19
	OCB	10	2
Sabotage	Trans	14	23
	OCB	—	—
Accident or Negligence	Trans	6	5
	OCB	1	—
Leaks	Trans	4	5
	OCB	1	—

One company responded "number of equipment unavailable." The spills reported by them do not appear on these tabulations. Above tabulation based on responses of 28 companies.