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Minimize the negative impact of oil contamination on Abu Dhabi power and desalination plants

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Abstract

The water resources in the Arab Gulf Region are very limited. The situation of the gulf area is dramatically more serious with the increasing population and much lower rainfall. Power and desalination plants are extensively built in the region to overcome the water shortage and provide power. Abu Dhabi Emirate of United Arab Emirates has five large power and desalination plants with a total capacity of 550 Million Gallon Water and 5000 Mega Watt per day. The heavy traffic of the oil tankers in the Arabian Gulf increases the risk of oil spillage which may reach the seawater intakes of one or more plants sited on seashore or in lagoons. Oil contamination of seawater intakes can affect the quality of the desalinated water and may cause the shut down of the plants in most cases. As the desalinated water is becoming a strategic product it is very essential to protect the plants from any oil contamination could reach their seawater intakes from any source of oil pollution like oil spill accident and leakage from oil terminals. Oil protection measures are installed at the seawater intakes of Abu Dhabi power and desalination and are deployed in the contingency events. The Water and Power Research Center of Abu Dhabi Water & Electricity Authority developed a powerful and effective early oil spill warning system to assist and support the plants by providing the plant managers with the trajectory and concentration of oil spill which may attack the plants. The advantage of the oil spill warning system is to give a warning signal in advance to the plant which may attacked by the oil spill so the oil protection measures can deployed and used to prevent the oil slick from approaching the seawater intakes of the plants.

The paper describes the developed oil spill warning system in Abu Dhabi. A case study on oil spill accident occurred in Abu Dhabi waters is used to demonstrate the application of oil spill warning system. The oil protection measures installed in Abu Dhabi Power and Desalination Plants are described.

Keywords: Oil contamination, Abu Dhabi, Power-desalination plants

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1. Introduction

The marine environment is a primary resource in achieving the social, economic, and strategic objectives of the Arabian Gulf Region. The discovery of oil in the region increases the importance of the Gulf due to the essential need of oil around the world. Nowadays, the Gulf is considered as a main source of water for desalination plants which were built along the coast. The desalinated water is used for domestic use in addition to industrial and agricultural purposes.

The discovery of oil fields in the gulf waters makes the marine traffic in the Arabian Gulf very busy. Large oil tankers, sail in the gulf and transport crude oil and other oil products from the Gulf Region to various parts of the world. The heavy traffic of the oil tankers increases the probability of accidental oil spills. The United Arab Emirates is an example of the Arabian Gulf countries where large desalination plants were built along the Arabian Gulf Coast. The Emirates is a federal country consisting of seven emirates located along the western coast of the Arabian Gulf. Abu Dhabi Emirate is one of these emirates and has four large power and desalination plants. More plants will be built in the future to satisfy the water demands.

It is very essential to prevent oil spills, in case they do occur, from reaching any plant intake to prevent significant reduction in the plant efficiency. To achieve this, the Research Center of ADWEA has setup an early oil spill warning system for Abu Dhabi Emirate to assess the risk of the oil spill reaching any of Abu Dhabi power and desalination plants. These plants are Umm Al Nar, Taweelah and Mirfa Power and Desalination Plants. The advantage of this system is to provide an advance warning signal to the responsible authorities so they are able to take the necessary action and to deploy the oil protection measures at the targeted plant intakes. An overview on the developed oil spill warning system and the procedures to be followed to predict the trajectory and concentration of oil slick will be presented. The established procedures by the research center will be clarified when discussing the case study on oil spill accident in Abu Dhabi waters.

2. Oil spill warning system

The oil spill warning system is a numerical transport model. The hydrodynamic forcing imposed in the model is the tidal flow, which is the main hydrodynamic driving force in the Arabian Gulf and Red Sea. The model considers the additional wind drift of the surface slick. A release of the oil spill in the model is distributed over a number of particles; where the mass of each particle represents the amount of a substance attached to it. The number of particles should be specified in the model. Modeling experience dictates that setting the particle number to 100,000 and 400,000 particles for instantaneous and continuous releases, respectively, is a safe assumption. The vertical dispersion of about 0.001 m^2/s should introduced in the model for well mixed flow condition. Practically, the simulation period is between 5 and 7 days. The tidal flow in the oil spill warning system is generated by the relevant hydrodynamic model simulates the tidal movement in the study area. Wind forecast during the simulation period should be introduced in the model to simulate the effect of the wind drift on the slick. The concentration distribution in the slick is computed by the process of spreading (due to gravity, viscosity and surface tension) and the turbulent diffusion. Because time is very critical in the oil contingency it is very important to know as quickly as possible how the slick moves and if it will attack one of the plants. To do the prediction