MONITORING WASTEWATER DISCHARGES FROM OFFSHORE OIL AND GAS FACILITIES IN THE SANTA BARBARA CHANNEL AND SANTA MARIA BASIN

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ABSTRACT

Sources of pollution to the Santa Barbara Channel and Santa Maria Basin include municipal sewage discharges, rivers, nonpoint sources, and various users of the ocean itself such as shipping, recreation, fishing and offshore oil and gas. Offshore oil and gas discharges are listed and discussed with typical examples given, including drilling muds and cuttings, produced water, deck drainage, and sanitary and domestic wastes. The EPA/MMS inspection program is described including the history of sampling, some challenges faced and an overview of the data. Finally, a brief description of the new General National Pollutant Discharge Elimination System permit is presented.

Keywords: Santa Barbara Channel, Santa Maria Basin, offshore oil and gas, monitoring discharges, NPDES, Environmental Protection Agency.

INTRODUCTION

The federal government monitors offshore oil and gas discharges in federal waters (greater than 3 miles from shore) to ensure that the water quality of the Santa Barbara Channel and Santa Maria Basin is not degraded. This paper includes a brief discussion of the water quality offshore southern California, and a description of the discharges commonly associated with offshore oil and gas facilities. The relationship between the Environmental Protection Agency (EPA) and the Pacific Region of the Minerals Management Service (MMS), including the monitoring program and the yearly workplan, and the key parts of the developing new General National Pollutant Discharge Elimination System (NPDES) permit are described.

Water Quality Offshore California

Marine and coastal water quality off the southern California coast is generally good, but localized areas are measurably degraded, and many small sources of pollutants exist. The most pristine waters occur on the outer banks and basins (e.g., Tanner-Cortes Banks), the windward sides of the Channel Islands, and the Santa Maria Basin (Buchman,1989; Southern California Coastal Water Research Program (SCCWRP), 1989; Mearns et al., 1990; MMS, 1992; Anderson et al., 1993; Eganhouse and Venkatesan,1993; MMS, 1996).

Sources of pollution to the Santa Barbara Channel and Santa Maria Basin include municipal sewage discharges, rivers and the associated onshore inputs, nonpoint sources, and various users of the ocean itself such as shipping, recreation, fishing and offshore oil and gas. Specific components, including concentrations and mass emissions of heavy metals, hydrocarbons, synthetic organics, and other pollutants may be found in A. D. Little (1985).

Natural petroleum seeps contribute significant amounts of hydrocarbons to the waters of the mainland shelf, including Point Conception, at Coal Oil Point and Santa Barbara-Rincon in the Santa Barbara Channel, and in Santa Monica Bay (Fischer, 1978; Anderson et al., 1993).

Offshore Oil and Gas Discharges

Thirteen of the twenty-three oil and gas platforms discharge their wastes according to the requirements of a General permit that has been administratively extended since it expired in June 1984; the remaining platforms have individual permits with varying requirements (a new General permit is being developed; this will be discussed later). Limits for both types of permits are given in Tables 1 and 2. The NPDES permits (EPA, 1983; 1992 and 1993) are public information and can be viewed at EPA's Region 9 Office in San Francisco.

EPA Region 9 and the MMS have had a Memorandum of Agreement since 1989, to allow EPA to use MMS's daily presence on the platforms as a vehicle to perform inspections, collect samples and to provide transportation for EPA during those occasions when they are present. Since 1990, MMS has made over100 visits to conduct inspections, collect samples and to provide information on overall EPA-related environmental compliance. A workplan is agreed upon each year specifying the number of inspections and sampling MMS will do for EPA. EPA has often accompanied MMS (the annual workplan specifies once per year).

Drilling Muds

Toxicity and free oil are the primary parameters of concern in drilling muds and cuttings. Toxicity is defined in terms of the concentration at which one-half of the population of a test organism dies; this is an LC-50 (or lethal concentration - 50% death). An LC-50 is determined by conducting a 96-hour acute toxicity bioassay with used drilling muds, collected at 80% of the depth of a well, or greater. EPA has determined that the greater portion of the additives in a drilling mud system would have been added in the later stages of a well, resulting in the highest potential toxicity. The historical toxicity limit has been 30,000 ppm. Any test that shows less toxicity (that is, greater than 30,000 ppm) is a passing test. Via the MMS/EPA Memorandum of Agreement, samples of drilling mud are occasionally collected and sent to EPA for compliance toxicity testing.

EPA also monitors free oil in drilling muds. Oil could occur in drilling muds from drilling into an oil-bearing formation or from oil added to a well to lubricate the drill pipe. Petroleum hydrocarbons, such as diesel or waste oil, may be used in a well to increase lubricity and to free stuck drilling pipe. The use of diesel oil is uncommon in the Pacific Region. Free oil is monitored in two ways: 1) a static sheen test and 2) examining the ocean surface for evidence of sheens near the discharge point (cuttings chute).

Other parameters that are monitored in drilling muds are: volumes discharged, the excess cement discharges, the use of chromlignosulfonate (prohibited), and mercury and cadmium in barite. Heavy metals, in general, are not monitored by EPA in drilling muds and cuttings (other than mercury and cadmium). Barium is commonly used in the form of barium sulfate (barite) as a weighting agent. Barium, as well as lead and zinc, were detected by investigators during the MMS-sponsored California Monitoring Program (CAMP) studies (SAIC and MEC 1995). The existence of lead and zinc in samples of drilling mud taken during these studies may have been due to the use of pipe-thread compound (pipe dope) used to lubricate the threads of drill pipe (Steinhauer et al. 1994). Other metals that have been detected in low levels in drilling muds include, silver, arsenic, copper, nickel and vanadium (SCCWRP1994). These metals are probably impurities in the barite or in other additives used in the drilling process. Also, as of this writing, at least one operator is using iron-based lignosulfonate; EPA prohibits the discharge of chromlignosulfonate, hence the use of the iron version of the lignosulfonate.

Produced Water

Fourteen platforms discharge produced water. Oil and grease (free and dissolved), heavy metals, cyanides, organic compounds, added treatment chemicals and radioactivity are all monitored in produced water effluents. All of these components are examined by sampling the effluent and conducting the appropriate EPA-approved analyses.

Sanitary and Domestic Wastes

These wastes are often treated with chlorine. The concern is that enough chlorine must be added to kill coliform bacteria but not so much that it affects the organisms in the ocean. Currently, the chlorine level in the effluent must be between 1 and 10 ppm. A few operators dechlorinate this effluent once the bacteria or fouling organisms have been killed.

Deck Drainage, Noncontact Cooling Water, and Fire Control System Test Water

The primary component of concern for these effluents is free oil (oil that can cause a sheen upon the ocean). Other monitoring parameters might include the use of chlorine (to prevent fouling of the fire water and cooling water systems), changes in temperature (noncontact cooling water) or the volume of the discharges(s). Often, those effluents that have the potential to cause a sheen, enter a sump where any oil physically separates. The oil cap is then pumped to the production system. None of these effluents are sampled by EPA or MMS, although some permits require that chlorine be sampled by the operator. Monitoring of free oil is done by reporting the presence/absence of oil sheens on the ocean surface.

INSPECTIONS AND MONITORING

EPA requires the operators to submit Discharge Monitoring Reports (DMRs). The requirements an operator follows depend on the type of permit the operator has: general or individual. The General Permit was issued in February 1982 (EPA 1983). Subsequent modifications occurred during 1983. However, the permit lapsed in June 1984. It has since been administratively extended until such time as a new General Permit could be developed.

Because new facilities were being installed and because EPA had promulgated New Source Performance Standards, a series of individual permits were issued in the mid- to late-1980s. These new permits were uniformly more strict and most required that a greater number of produced water parameters be monitored. This two-tiered system of permits rapidly became unwieldy for EPA since each individual permit had to be reevaluated and reissued every five years (the standard term for such permits). Because of this and other reasons, a new General Permit is being developed (see below for further discussion).

EPA uses information from the DMRs to ascertain: (1) if the operator is meeting the overall requirements of his permit and (2) if any exceedences of the specifics of the permit has occurred. For produced water discharges, MMS has compiled, in spreadsheet form, most of the information available from 1988 to the present. Table 1 shows a typical General Permit spreadsheet page and Table 2 shows a typical Individual Permit page. These two tables indicate the extensive amount of information available regarding oil and gas-related discharges. Included in these tables (and the spreadsheet as a whole) are data from EPA/MMS sample collections. Sampling has occurred once or twice per year (except for 1996) and the data are useful for comparisons between operator-collected data and EPA/MMS-collected data. Some key points regarding the information in Tables 1 and 2 are:

Table 1. Typical worksheet for a *General* NPDES Permit for Platform X and Operator Y.

Parameter	Flow (MGM)	Flow	Oil & Grease	Arsenic	Cadmium	Total Chromium	Copper	Cyanide	Lead	Mercury	Nickel	Silver	Zinc	Phenol
Frequency	1/month	(MLM)	1/month	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Permit Limit	(mg/l)		72	0.032	0.012	0.008	0.02	0.02	0.03	0.00006	0.08	0	0.08	0.12
DATE				"<" = Analyte was Below Detectable Limits; "*" = EPA/MMS-collected sample.										
Jan-90	1.048	4.1438	53											
Feb-90	0.969	3.6677	18.5											
Mar-90	1.0801	4.0882	48.25											
Apr-90	0.747	2.8274	27	< 0	< 0	< 0	< 0	0.04	< 0	< 0	< 0	< 0	<	0.61
May 90**	0.889	3.3649	331.67											
May 90*			17											
Jun-90	0.7245	27.422	48.5											
Jun 90*			22	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	<	0.008
Jul-90	0.752	138.27	30.6											
Aug-90	0.7678	2.9061	25.5											
Sep-90	1.2483	4.7248	25.78											
Oct-90	1.3319	5.0412	21.93											
Nov-90	1.2339	4.6703	24.03											
Dec-90	1.0129	3.8338	47.25											
Subtotal '90	**11.851**	**37.9232**	**52.929**	**0**	**0**	**0**	**0**	**0.02**	**0**	**0**	**0**	**0**	**< 0**	**0.31**
Jan-92	1.4356	5.4337	10											
Feb-92	1.1112	4.2059	6.05											
Mar-92	1.5382	5.8221	13.03											
Apr-92	0.5569	2.1079	35.6	< 0	< 0	< 0	< 0		< 0	< 0	0	< 0	< 0	0
May-92	0.8828	3.3414	30.55											
Jun-92	0.8442	3.1953	21.25											
Jul-92	0.8619	3.2623	15.78											
Aug-92	0.7487	2.8338	23.05											
Sep-92	1.0778	4.0795												
Sep 92*			8	< 0	< 0	0.0042	0.002	0.012	< 0	< 0	< 0.018	< 0	<	< 0
Oct-92	0.8098	3.0651	19.45											
Nov-92	0.761	2.8804	12.75											
Dec-92	0.7744	2.9311	29.75											
Subtotal '92	**11.403**	**43.2**	**18.772**	**0**	**0**	**0.0021**	**0.001**	**0.012**	**0**	**0**	**0.01**	**0**	**0**	**0**
Running Sum	**59.032**	**81.123**												
Running Mean	**2.46**	**9.31**	**37.164**	**0**	**0**	**0.00105**	**0.0005**	**0.013**	**0**	**0**	**0.0045**	**0**	**0**	**0.1545**

Table 2. Typical worksheet for an *Individual* NPDES Permit for Platform X and Operator Y.

Parameter / Frequency	Flow (MGM) 1/month	Flow (MLM)	Oil & Grease 1/week	Arsenic qrtrly	Cadmium qrtrly	Total Chromium qrtrly	Copper qrtrly	Cyanide qrtrly	Lead qrtrly	Mercury qrtrly	Nickel qrtrly	Silver qrtrly	Zinc qrtrly	Phenol qrtrly
Permit Limit	(mg/l)		42	0.032	0.004	0.008	0.012	0.004	0.008	0	0.02	0.0028	0.08	0.12
DATE				"<" = Analyte was Below Detectable Limits; "*" = EPA/MMS-collected sample.										
Jan-94	4.389	16.6124	26.8											
Dilution Ratio = 750:1														
Feb-94	4.553	17.1461	25.3	< 0	< 0	< 0	0.000013	< 0	< 0	< 0	< 0	< 0	8E-05	0.00077
Mar-94	9.45	35.7683	10.2											
Apr-94	6.381	24.1521	11.1											
May-94	7.449	28.1945	14.8	0.00301	< 0	< 0	< 0	< 0	< 0	< 0	0	< 0.0003	< 0	0.00071
Jun-94	6.774	25.6396	17.9											
Jun 94*								< 0		<	0			
Jul-94	7.197	27.2406	11.8											
Aug-94	8.682	32.8614	5.8	0.00301	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0.0081	0.00065
Sep-94	8.163	30.897	12.5											
Oct-94	6.681	25.2876	7.2											
Nov-94	8.895	33.6676	7.4	< 0	< 0	0.00002	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0
Dec-94	6.231	23.5843	9.4											
Subtotal '94	**84.822**	**321.051**	**13.35**	**0.0015**	**0**	**5E-06**	**3E-06**	**0**	**0**	**0**	**0**	**0.00008**	**0.0020**	**< 0.00053**
Jan-95	7.455	28.2172	12.7											
Feb-95	6.141	23.2437	7.8	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	0.0089	< 0
Mar-95	2.157	8.1642	13.8											
Apr-95	3.456	13.0810	11											
Dilution Ratio = 395:1														
May-95	3.204	12.1271	16	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	< 0	0.00088
May-95 - Optr. Dup.			17.5											
Jun-95	4.167	15.7721	13.5											
Jul-95	5.535	20.9500	10.3											
Aug-95	3.552	13.4443	16.5	< 0	< 0	< 0	< 0	< 0	2E-05	< 0	< 0	< 0	< 0	< 0
Sep-95	6.732	25.4806	14.7											
Sep 95*			8	< 0	< 0	< 0	< 0	0	2E-05 → see next					
Oct-95	5.976	22.6192	6.6											
Nov-95	2.298	8.6979	9.8	< 0	< 0	< 0	< 0.00202	< 0	< 0	< 0	< 0	< 0	< 0	0.00581
Dec-95	2.184	8.2664	7.6											
Subtotal '95	**52.857**	**200.06**	**11.84**	**0**	**0**	**0**	**0.0004**	**4E-06**	**4E-06**	**0**	**0**	**0**	**0.0018**	**0.00167**
Running Sum	**137.68**	**521.12**				**0**								
Running Mean	**5.7366**	**21.713**	**12.538**	**0.0007**	**0**	**2E-06**	**0.0002**	**2E-06**	**2E-06**	**0**	**0**	**0.00003**	**0.0019**	**0.00117**

Table 2. Typical worksheet for an I*ndividual* NPDES Permit for Platform X and Operator Y (continued).

Parameter	Selenium	Ammonia	Naphthalene	2-4 Dimethylphenol	Benzene	Toluene	Ethyl Benzene	Benzo (a) Pyrene	Bis (2ethylhexl) phthalate	Ra^{226} (pCi/L)	Ra^{226} (pCi/L)
Frequency	qrtrly	qrtrly	qrtrly	qrtrly	qrtrly	qrtrly	qrtrly	qrtrly	qrtrly	biannual	biannual
Permit Limit	0.06	2.4	0.0235	none	0.0059	0.05	0.0043	0.003	0.0035	monitor only	monitory only
DATE		"<" = Analyte was Below Detectable Limits; "*" = EPA/MMS-collected sample.									
Jan-94											
Dilution Ratio = 750:1											
Feb-94	< 0	0.18667	4.50E-05	5.50E-05	0.00147	0.0013	< 0	< 0			
Mar-94											
Apr-94											
May-94	< 0	0.19973	0.00001	< 0	0.00021	0.0001	0.00002	< 0	< 0	< 0	< 0
Jun-94											
Jun 94*					0.00002	4E-05	2.4E-05	< 0	< 0		
Jul-94											
Aug-94	< 0	0.35952	0.00007	0.00005	0.00186	0.0004	0.00003	< 0	< 0	< 0	< 0
Sep-94											
Oct-94											
Nov-94	0.00007	0.31957	< 0	< 0	0.00057	0.0002	0.00002	< 0	< 0	0.07989	0.13582
Dec-94											
Subtotal '94		**0.26637**	**3E-05**	**3E-05**	**0.0008**	**0.004**	**2E-05**	**0**	**0**	**0.0266**	**0.0453**
Jan-95											
Feb-95	< 0	0.253	< 0	< 0	0.00019	0.0001	0.00001	< 0	< 0	0.02996	0.06791
Mar-95											
Apr-95											
Dilution Ratio = 395:1											
May-95	< 0	0.24747	< 0	< 0	0.00129	0.0005	0.00006	< 0	< 0	0.0851	0.07828
May-95 - Optr. Dup.											
Jun-95											
Jul-95											
Aug-95	< 0	0.07323	< 0	< 0	0.00106	0.0005	0.00003	< 0	< 0	0.01566	0.05556
Sep-95	< 0	4.9E-05	0.00011	8.6E-05	0.0081	0.0033	0.00028	< 0	< 0		
Oct-95											
Nov-95	< 0.00002	0.06061	< 0	0.00006	0.00228	0.0025	0.00023	< 0	0	0.15455	0.34848
Dec-95											
Subtotal '95	**2E-06**	**0.12687**	**2E-05**	**3E-05**	**0.0026**	**0.0014**	**0.0001**	**0**	**0**	**0.0713**	**0.1376**
Running Mean	**0.00001**	**0.18887**	**3E-05**	**3E-05**	**0.0017**	**7E-05**	**7E-05**	**0**	**0**	**0.0522**	**0.098**

- Units for the first two columns are millions of gallons per month (MGM) and millions of liters per month (MLM). All other units are mg/l.
- Annual subtotals are summed for the first two columns and averaged for the remainder.
- Less than (<) symbols indicate that the analyte was below practical quantitative limits. In other words, the analyte might have been present, but not at levels that the analytical machinery could dependably detect. The analytical industry convention (and EPA's as well) in cases as these is to assume that the analyte was not present since it is not possible to show presence or absence at such low levels.
- A single asterisk (*) indicates an MMS/EPA sampling event.
- Double asterisks (**) indicates a violation by the operator, usually also reported by the operator.
- Most platforms have developed dilution ratios via modeling studies. The example shown in Table 2 includes a dilution ratio of 750:1. This means that an operator is allowed by his permit to apply a dilution number, which, according to the modeling study, will occur before the effluent has traveled 100 meters. Once the effluent passes the 100 meter mark, all parameters must be below the level for that parameter given in the row indicated by "Permit Limit." The permit for Platform Grace, which is no longer producing oil and gas nor discharging, did not allow the use of a dilution ratio; it is the only permit of that type in the Pacific OCS.
- Although Table 1 does not show a dilution ratio, EPA still must apply one in order to assess whether an operator, who is allowed a dilution ratio, violates his permit based on end-of-pipe analyses. The lowest dilution ratio in the Pacific OCS was 47:1. Even given this conservative number (most dilution ratios are between 500:1 and 1500:1), none of the values given in Table 1 exceed the values given in the "Permit Limit" row.
- The more recently-issued individual permits cover a greater range of potential produced water parameters. These parameters added for the Individual Permits issued by EPA are given in Table 2. Generally, only the high-end hydrocarbons were detected with any regularity and at low levels. Presently, only two platforms with individual permits are discharging produced water.

A spreadsheet similar to that represented by Tables 1 and 2, but not yet in final form, contains information on drilling discharges and the various monitoring parameters required by EPA. In addition, other information contained in DMRs, such as volumes of sanitary and domestics wastes (sewage), amount of chlorination, volumes of deck drainages and number of times oil slicks and sheens have been sighted can be developed into a more comprehensive picture of discharges occurring from oil and gas facilities in the MMS Pacific Region. This information may be compiled by MMS for future analysis.

SCCWRP (1994) conducted an analysis of Discharge Monitoring Reports (DMRs) which the operators submitted to EPA in 1990 as required by the various NPDES permits. The author reported that nickel was the most common parameter detected followed by cyanides (25%), while cadmium was not detected in any of the samples taken by the operators.

During the eight years since the SCCWRP analysis was conducted, the data shows that:

- nickel was the most prevalent metal;
- while cyanides were found at 11 of the 14 platforms that discharged produced water, levels were generally low (with one exception); and
- cadmium was detected at only five of the 14 platforms (Table 3).

Phenol, a light-end hydrocarbon in the form of a benzene ring with a hydroxyl (OH) group attached, is more commonly detected in produced water than other parameters because light-end hydrocarbons dissolved in produced water are difficult to extract using current treatment technologies. The most common treatment system on the platforms and at onshore treatment facilities include an air-floatation device, near the end of the treatment system, where air and emulsion-breaking chemicals are bubbled through the produced water. The oil floats to the surface and is then skimmed over a weir and into the production system. Phenols and other light-end hydrocarbons are removed moderately well in this type of treatment as indicated by the small number of exceedences of phenol limits reported by the operators and detected by EPA.

Only two parameters, arsenic and cadmium, were detected at less than nine platforms (five each) since the beginning of the data set in 1988 (Table 3). All other parameters have been detected at nine to twelve platforms with phenols being detected at 13 platforms. This information indicates that while most of the parameters are commonly detected at most platforms, only a few platforms contribute. For example, arbitrarily choosing 25% as a cut-off, only three platforms found total chromium more than 25% of the time (values greater than 25% are in bold in Table 3). Similarly, two, one and one platforms found copper, cyanide and mercury, respectively, more than 25% of the time. As discussed above, phenol is the most commonly detected parameter and this is reflected in the table. Overall, 22 of the 140 entries, or 15.7%, (excluding phenols) have values of greater than 25%.

The last column in Table 3 shows the number of parameters detected at each platform according to the data in the spreadsheet. The platforms seem to fall into three loose groups in terms of number of parameters detected: three or less; six to nine; and ten and eleven. It is unknown why this variation exists. Some reasons could be: 1) the type and efficiency of the treatment systems; 2) natural variations in

Table 3. Percentage of produced water parameters that have been detected at all discharging platforms (common to all NPDES permits currently in effect), total number of platforms and the mean number of times a parameter was detected (#/Mean %), and the number of parameters (out of 11) detected over time at each platform (#para.). Percentages greater than 25% are in bold.

Platform	Arsenic	Cadmium	Total Chromium	Copper	Cyanide	Lead	Mercury	Nickel	Silver	Zinc	Phenol	# para.
1	0	0	0	0	20	0	0	0	0	**40**	**100**	3
2	0	16.7	**33.3**	0	0	0	0	0	0	0	**42.9**	3
3	0	0	20	20	0	0	0	0	0	0	**100**	3
4	4.5	0	**68.2**	4.6	18.2	4.6	4.5	**63.6**	9.1	0	0	8
5	0	0	16.7	16.7	15.4	16.7	15.4	**33.3**	25	16.7	**53.9**	9
6	0	7.1	14.3	14.3	15.4	21.4	7.2	**28.6**	21.4	21.4	**71.4**	10
7	0	7.7	0	15.4	15.4	0	0	15.4	23.1	15.4	**64.3**	7
8	0	0	7.1	14.3	13.3	21.4	13.3	**28.6**	21.4	21.4	**80**	9
9	0	0	6.7	6.7	0	13.3	0	6.7	0	7.1	**73.3**	6
10	**36.4**	0	18.2	18.2	8.3	18.2	8.3	**27.3**	18.2	**40**	**90.9**	10
11	7.1	0	7.1	21.3	7.1	7.1	7.2	**28.6**	15.4	21.4	**85.7**	10
12	10.8	2.7	21.6	**27**	5.3	13.5	7.9	21.6	**27**	**58.3**	**59.5**	11
13	18.8	6.3	**100**	**37.5**	12.5	18.8	0	**50**	**33.3**	**35.7**	**93.3**	10
14	0	0	10	10	**66.7**	0	**30**	10	0	**30**	**77.8**	7
#/Mean%	**5/5.5**	**5/2.9**	**12/23.1**	**12/14.7**	**11/14.1**	**9/9.6**	**9/6.7**	**11/22.4**	**9/13.9**	**11/22.0**	**13/70.9**	**11**

Table 4. Number and percent of exceedences reported by the operators in their Discharge Monitoring Reports compared to the total number of analyses conducted and the number of EPA/MMS inspections.

	Parameter [a]						
	Oil and Grease	Chromium	Copper	Cyanide	Mercury	Silver	Phenols
Number of Exceedences Reported by the Operators	6	1	1	2	1	2	1
Analyses Reported by the Operators by Parameter	1158	195	194	191	198	188	196
Percent Exceedences	0.086	0.51	0.52	1.05	0.51	1.06	0.51
Number of Exceedences Detected out of 105 EPA/MMS Unannounced Inspections	1 (0.95%)	0	0	0	0	0	0

[a] No exceedences were reported by the operators or detected by EPA/MMS for any other parameters.

the produced water (due to type of oil, formation characteristics, etc.); 3) the ability of various analytical laboratories over time to refine their techniques or some other or combinations of reasons.

Table 4 shows information on exceedences as reported by the operators compared to that detected by the unannounced inspections by EPA and MMS since this cooperative inspection program began (1990). The parameters shown are only those where exceedences were reported. No other exceedences were reported for any other parameters, including those in the individual permits. The percent of occasions exceedences occurred ranged from 1.06% (silver) to 0.086% (oil and grease). Note that the number of oil and grease analyses is an order of magnitude larger than those for the other parameters, yet the oil and grease exceedence percentage is less by an order of magnitude than the other parameters. While this information has been gathered by the operators, when compared to the data from the EPA/MMS inspections, little difference is evident.

The New General Permit

As noted above, a new General Permit is being developed; the lead agency is EPA. Primary stakeholders are the operators and various government agencies, including the

MMS, California Coastal Commission, Santa Barbara County Energy Division and environmental groups including the Environmental Defense Center and the National Resources Defense Council. The new draft permit contains some significant changes (compared to either the old General Permit or the current individual permits) regarding produced water monitoring. First, a system known as Reasonable Potential is being proposed. If, after technology-based limits are applied, EPA projects that an operator may exceed water quality criteria, a Water Quality-Based Effluent Limitation (WQBEL) must be imposed (EPA 1996). To determine if a WQBEL is needed, EPA must first determine if a discharge, "has the reasonable potential to cause, or contribute to an excursion of numeric or narrative water quality criteria." This means that an operator must monitor those components of his produced water effluent that have a Reasonable Potential to cause harm to the environment. If there is no Reasonable Potential, then no WQBEL is necessary. When making this determination, EPA is required to consider several factors including: 1) existing controls on point and nonpoint sources of pollution; 2) where appropriate, the dilution of the effluent in the receiving water; 3) whether technology-based limits are sufficient to maintain State water quality standards; and 4) other information, such as compliance history, dilution, data from similar facilities, effluent monitoring data and models. For any effluent, a component that does not exist, or is in very low levels in the effluent, will not cause harm to the environment and will not be monitored, even if it was monitored for in the past. For produced water, this applies, in general, to most metals and some items in the individual permits (Table 2).

Second, as a monitoring tool only, not subject to enforcement, toxicity of produced water is proposed to be measured by bioassay techniques. If toxicity is detected (the limit is not currently set), the operators will undergo a process known as Toxicity Reduction Evaluation/Toxicity Identification Evaluation. EPA will work with the operator and help to reduce the toxicity of the produced water effluent and, by extension, harm to the environment.

The permit is still under development and may be in draft to the stakeholders in late summer or early fall 1999.

CONCLUSIONS

The data from eight years of DMRs, submitted by operators to EPA, has been analyzed. While a few violations have been reported, no detectable harm to the environment occurred. The data indicate that some metals are more prevalent than others in the discharge (namely nickel) and that light-end hydrocarbons are commonly included in the produced water discharge. All of the parameters were at low levels in the effluent and most were not detectable when chemically analyzed.

Given that the water quality of the Santa Barbara Channel and the Santa Maria Basin is generally good, any changes in the water quality should be detectable at some reasonably low level. According to the monitoring efforts, both by the operators and by EPA and MMS, offshore oil and gas operations generally do not exceed the limits of their permits as given by EPA. Therefore, it can be reasonably concluded that offshore oil and gas operations do not affect the water quality of the Santa Barbara Channel and Santa Maria Basin.

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