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THE BAY MARCHAND FIRE

By W. M. MARSHALL
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Before we review the Bay Marchand fire, let's take a brief look at offshore operations in general.

Louisiana Offshore

The industry's daily production offshore Louisiana is 1.3 million barrels of oil and 8.8 billion cubic feet of gas. This is about one-eighth of the U.S. total oil production and one-seventh of the gas production. Since 1965, oil production has doubled and gas production has trebled. This is a vital part of our energy supply which, nationwide, is not increasing as rapidly as the energy demand. This is why you are hearing more these days about the developing "energy crunch." The offshore areas are vital to our future supply of gas and oil. There is no question in my mind that the oil people will develop and produce these reserves with respect for — and protection of — the environment. I think Bay Marchand showed that we have the ability and the dedication to deal effectively with emergencies and threats to the environment.

Deepwater operations are carried out on modern platforms that are commonly designed for 24 wells. Drilling and completing the wells may take one and a half to two years. The rig is then removed and production facilities are installed. These facilities are as sophisticated as some onshore plants, and are equipped with automatic safety devices including emergency shut-down capability. One of the most important factors for a safe facility is a well-planned and detailed system design. The emphasis here is on *system*. It is pertinent to note that a typical offshore facility containing 20 wells will normally have over 300 individual safety devices such as pressure sensors, fluid level sensors and automatic valves.

One of the more unusual safety items being fabricated for installation on five of our platforms is a large, inflatable slide for emergency evacuation of personnel. This type of slide was originally developed for evacuation of personnel from the 747 aircraft, but has now been adapted for use on offshore platforms.

Shell currently holds the world record with a deepwater platform in 373 feet of water. If set alongside the Washington Monument, the drilling derrick would rise above the 555-foot monument. The platform has two decks and, together, they are as big as a football field.

The platforms are fabricated on land, lying on their sides, and are then skidded onto a barge and towed to the desired location. The jacket is winched off the barge into the water, where it floats on its side. It is uprighted with the assistance of a barge-mounted crane and controlled flooding of the legs. Steel piles are driven through the legs to anchor the jacket to the Gulf floor. The deck sections are then mounted on the jacket.

In 1954, the Federal Government began holding offshore sales, with 5,000-acre blocks leased to the company submitting the largest bonus in dollars. In addition, a one-sixth royalty is paid on all production. The offshore drilling, construction and production activities have been affected by the frequency and size of lease sales. The petroleum industry's expenditure-income balance sheet for offshore Louisiana as of January, 1971, shows estimated total expenditures of $15.9 billion. The amount paid to state and federal agencies in the form of bonus and rentals, royalty and production taxes puts them in the black by about $5.5 billion. The payout position of the industry is about $4.6 billion in the *red.*

Bay Marchand

Shell's Bay Marchand operation is located

about 65 miles south of New Orleans. Platform "B", site of the blowout and fire, was located approximately seven miles from shore. The platform faced an arc of 58 miles of sand beaches, over a span of 70 miles. It was 15 miles to the nearest point on Grand Isle and 10 miles to the 30,000-acre Wisner Wildlife Management area. Prime shellfish harvesting areas are scattered all along the coastal area and inland bays. South Louisiana is the terminus of the Mississippi flyway, and many thousands of migratory waterfowl spend the winter in this area. Large flocks of birds both migratory and resident were frequently seen in the area.

Shell's Platform "B" was the largest platform in the Gulf. The 12-pile structure was installed in 55 feet of water in August, 1969. It was designed for 36 wells and two full size drilling rigs. Storm Drilling Company's twin rigs, 20 and 21, were installed on the platform and drilling commenced in September, 1969. At the time of the fire, 21 duals and one single well had been completed. Drilling of the 23rd and 24th wells was underway. Daily production from the platform was 17,500 barrels of oil and 40 million cubic feet of gas. The platform was operated in full compliance with government regulations.

Beginning of the Fire

The fire started on Platform "B" at 9:45 A.M. on December 1, 1970. Sixty people were on the platform when it began. Four people lost their lives. Over half were injured. Fire and "abandon platform" drills, which are routinely conducted once each month on all platforms, were credited with preventing the injuries from being even more extensive. The people were recovered quickly and transported to area hospitals. Within the hour after word of the traffic incident reached the office, key personnel were flying to the scene for an on-site inspection. The entire platform was engulfed in a huge ball of flame, and the roar of the fire was so loud it could be heard over the din of the aircraft engines. Two decisions were made immediately. First, to set up a special organization, and second, to let the fire burn, and drill relief wells.

Personnel from the Offshore Division who were familiar with operations at Bay Marchand were selected to form the core of the emergency group. All of these people were relieved of their regular assignments in order to give their undivided attention to the emergency effort. Personnel were drawn from other divisions within Shell's organization to complete the emergency group, and consultants were retained wherever needed. The emergency organization consisted of three operating groups. These handled relief wells, firefighting and pollution control. A services group manned a special terminal, and handled materials, communication and transportation.

Relief Wells

The call went out to the industry for jack-up drilling rigs and support equipment. The response was immediate. Companies like Amoco, Continental, Mobil, Forest, and Pennzoil sacrificed their schedules and released their rigs to Shell.

Stormdrill VI was put under two the very first day and arrived at Bay Marchand on December 4. It was immediately assigned to drill a relief well to B-21, the well that started the inferno because of a serious human error. Control valves in the B-21 tree were not completely closed, and the well pressure broke thru a bridge in the tubing and blew out.

A total of 10 relief wells were drilled with five drilling rigs. We felt our chances of "killing" a well were extremely good if the relief well could be drilled into the productive zone within a 25-foot radius of the blowout well. The idea was to pump sea water down the relief well until communication was established as indicated by flame behavior. Once communication of the 10 relief wells hit within our target, and the seventh, B-17, just missed. Even though some of the relief wells missed the target, we killed 10 of the 11 blowout wells with this technique.

Halliburton pumping equipment for the kill operation was mounted on small jack-up rigs that had the drilling equipment removed. Being mobile, the pumping platforms could be positioned within stepping distance of the drilling rig. Unlike barge-mounted pumps, the platforms offered round-the-clock operations, unaffected by sea state.

Pollution Control

Mobile pollution-control equipment was selected for collecting and skimming oil not consumed by the fire. No effort was made to contain the oil, as this was thought to be futile. The "oil scoop" formed the backbone of our pollution control fleet. The oil scoop is basically a floating api separator, and it proved to be the most successful piece of oil recovery equipment used at Bay Marchand. Our mode of operation was to tow the oil scoops to the site, and deploy them downwind, as close to the burning platform as the tugs could safely stand. In this manner, oil was funneled into the skimmer before it could spread.

Another device, used to chase oil, was the skimmer barge. Two 500-foot sections of navy boom were used to funnel oil to an adjustable saw-tooth weir mounted on the leading edge of the barge.

The 500-foot sections of navy boom used on the skimmers required periodic repairs. This was done in assembly-line fashion, utilizing the "trolley barge". Men worked on both sides of the boom as it was moved across the barge. The trolley barge was stationed in protected water at the mouth of Bayou La-Fourche.

Another piece of the pollution control fleet was a shallow-water skimmer designed to chase oil in the bays. This unit was self-propelled by two outboard motors, and drew only one foot of water. Gates on the front fold out to form a funnel like the navy boom. This unit was designed by Shell engineers during the emergency, but was never used because little oil reached the bays.

Shoreline Protection

The shoreline protection plan was made on the assumption that a major spill might occur. Twenty-three thousand bales of straw were deployed on the beaches. Mulchers and pick-up equipment were positioned at strategic locations along the beach. Fortunately, the need for this equipment never developed. No straw was used.

Oil did reach the beach on two occasions after prolonged periods of southerly winds. However, the beaches in this area were hard-packed sand, and the beaches cleaned themselves quickly.

Bird-cleaning stations were deployed in the area but were not required because birds were not contaminated with oil.

Operations at Platform "B"

As the days wore on, the platform continued to deteriorate as exposure to the intense heat destroyed structural integrity. Back-up kill methods were researched in the event extreme difficulty with the relief wells was encountered. Diver inspections revealed that access to the wells beneath the water was almost completely choked off with a fence of debris, formed as the platform continued to collapse.

Beginning December 4, two spray barges pumped almost constant streams of water, at 13,000 gallons per minute in an effort to cool the steel and retard structural deterioration. Despite this effort, the platform continued to collapse as the intense heat sapped the strength from the support members. Heat exposure caused tubing and casing strings to bend, and even loop, into the water. This was a special problem because combustion efficiency was reduced, and kill operations would be hampered by lack of visual observation of the well flow.

To deal with the looped wells, a sand-cutting technique was devised to cut the bent tubing strings. It consisted of a Shell-designed boom and delivery system and a Dowell-designed cutting head. Water, sand and nitrogen were pumped, at high pressure, through nozzles in the cutting head.

The tubing strings were cut successfully, and the wells spewed upward unobstructed. The combustion efficiency was almost 100 percent, with no evidence of oil on the water. This condition prevailed for most of the final

two months of the fire.

The Last Well

Ten wells were killed, but all attempts to kill the eleventh, B-4, had proved unsuccessful. When a good weather forecast promised ideal oil skimming conditions, we extinguished B-4 with a stream of high pressure water. Mr. Adair and his men, assisted by our field team, capped B-4 on April 16, 1971. It was the 136th day of the emergency.

After the Fire

After the fire was put out, debris was removed from the cluster of well stubs, and each of the wells was secured with a new tree to keep the wells under control. To establish a tieback point, the ten and three-fourths inch casing was cut below the water level, and a spool was set on the ten and three-fourths stub and held in place with slips. The upper tree was set, which sealed the seven-inch annulus and provided a tree valve for each tubing string. It took about three months to complete the salvage and clean-up operation. At this point in time (July, 1971) we had spent $29 million. This is "out-of-pocket" cost and does not include a few million dollars in lost assets and several million dollars worth of burned oil and gas.

Restoration and Redevelopment

Planning for restoration and redevelopment at Bay Marchand began long before all of the wells were secured. We chose to install two platforms to replace Platform "B". With this scheme, work to salvage the wells can be conducted on one platform simultaneous with drilling new wells from the second platform, to complete development originally planned from Platform "B".

A new jacket was installed over the old ton derrick barges. The new jacket is called Platform "D".

Restoration of the wells began during November, 1971. The restoration operation basically involved raising the wellhead from water level to the new platform deck, about 50 feet above the water. The wells are being rebuilt, not only from the waterline up, but also for some distance below the waterline, to be sure that tubulars damaged by heat and bending are removed and replaced. New, permanent wellheads have been installed, and the tubing and casing strings pressure-tested to insure integrity.

The last chore in this long series of operations was to clean out the interior of the tubing. We found debris and junk lodged on top of the subsurface safety valves. Much of the junk consisted of steel balls, about the size of buckshot, that were formed when molten steel dripped into the tubing during the fire. The clean-out operation has been slow and tedious. It was not until late March, this year, that we tested the first well.

We hope to restore 19 of the original 22 producers by early fall, 1972. Only three wells have been abandoned due to poor mechanical condition. Production tests, so far, are comparable to tests before the fire, so we are optimistic as to future production capability. All of the restored wells will remain *shut-in* until the operation is completed, and essential facilities are installed.

While the restoration operation is in progress, new wells are being drilled by Shell's Rig 12 from the nearby "C" Platform. The seventh well is drilling now, and several more remain to be drilled. The two platforms are joined by a 200-foot bridge.

The restored wells should be returned to production late this summer or early fall, and drilling new wells will continue until about the end of 1972.

In closing, let me assure you that the fishing is still good at Bay Marchand.

WHAT'S NEW AT DOT

By W. M. MILLER
Division of Transportation, American Petroleum Institute, Washington, D.C.

When DOT was formed, it found the area of safety rather barren as far as coordinated efforts were concerned and a complete void in many segments. The DOT set out to bring order out of the chaos it found and to present to the country a well-kept, attractive safety picture, to get the business of transportation organized and make it safe!

The Department of Transportation was established April 1, 1967 and was charged with providing "a national transportation system to handle all needs safely, economically, efficiently, quickly, and with maximum choice and performance." The most obvious area of endeavor is safety—a function formerly resting with the ICC as far as rail and highway matters are concerned.

There is also the Bureau of Motor Carrier Safety whose regulations cover commercial truck operations; the National Highway Traffic Safety Administration which sets standards for new truck equipment; the Federal Railroad Administration which handles matters pertaining to tank cars; and the Office of Pipeline Safety which, as its name implies, covers pipeline safety.

Pending or proposed regulations can be found in the *Federal Register*, which is published everyday except Sundays and holidays and is "must" reading for those whose responsibility is to stay abreast of current regulations.

The Office of Hazardous Materials has proposed 105 dockets since the establishment of DOT. Of those, 90 dockets are completed and 15 are still pending. This does not mean that any of the so-called closed dockets cannot be added to or reopened as necessary. This does happen fairly frequently.

The Bureau of Motor Carrier Safety was moved from the old ICC to the Department of Transportation when it was formed, and as a consequence did not have to start from scratch in its rulemaking procedures. Therefore, we find only 42 dockets that have been proposed by them since their formation of which seven are still pending.

The National Highway Traffic Safety Administration has proposed innumerable regulations about which I am not sure anyone can be specific as to numbers. Almost everyday in the *Federal Register* there is some change or new proposal. Since so many of these deal with standards for highway vehicles, such as motorcycles, automobiles, home trailers, etc., we do not attempt to keep current with all of their dockets. Those of particular interest to the petroleum industry are reviewed and sent out to our members. However, rarely do we comment on these dockets.

The Federal Railroad Administration is primarily concerned with operating rules and equipment for the railroads. Our interest is localized in the tank car transportation by rail, and most of those proposals appear in the dockets submitted by the Office of Hazardous Materials.

Now to get to the meat of our discussion: "What's new." First, in the area of hazardous materials there are two pending dockets which have considerable impact on the petroleum industry. Docket HM-102 proposes (1) to change the definition of a flammable liquid and (2) to add a new category of combustible liquids. The current definition of a flammable liquid is restricted to those liquids whose flash point is 80°F and below as determined by the open cup method of testing. The proposed definition would raise this figure to below 100°F. as determined by the closed cup method. For the petroleum industry this has little impact as few additional products fall in this particular area of 80°F open and 100°F closed. In fact, last February the American Petroleum Institute, after a number of years wrestling with this problem, established for the petroleum industry a defi-

nition of flammable liquids, a definition which is almost identical to that proposed by DOT.

The question of the new combustible category is a horse of another color. This proposal would set a combustible category between 100°F closed cup to 200°F closed cup. This category would affect fuel oils, diesel fuel, etc. Many of our members have expressed concern about the establishment of this category, but in the interest of uniformity throughout the country, they have generally agreed to accept it. Incidentally, the uniformity of which I speak would make this category compatible with the NFPA definition, which is adopted by many states.

The fears that our members have expressed about the establishment of this new category have to do with the possibility that very extensive regulation *might* be applied to this category, which at the present time is not regulated. The DOT has unofficially assured me that they presently intend to use this category primarily for warning emergency forces and others of the hazards of the material being transported. I personally have no illusions about the fact that somewhere down the line, if this category is put into the regulations, we will be faced with proposals for its regulation beyond merely placarding requirements. Unless there is a change in the thinking of our members, I would expect that we would be prepared to fight against the extension of regulations in this area.

The subject of placarding brings us to the next pending docket of considerable interest to the petroleum industry. This is Docket No. HM-103, whereby the Office of Hazardous Materials in an Advance Notice of Proposed Rule Making is soliciting comments on a new placarding system which would be used by all modes of transportation. As I am sure you know, today there is one system for use by highway and another for use by rail.

In essence, the new system contains three elements: (1) the category of the material being transported, such as "flammable;" (2) a number which will be keyed to instructions as to how to handle emergencies involving materials carrying that number; and (3) a pictorial representation which will be acceptable for international use. All three of these items would be displayed on a diamond shaped placard.

The provisions of this order would apply to packages and bulk shipments. The petroleum industry has filed a statement on this Notice, pointing out the complexity of the proposed system. Also, we have suggested that bulk shipments do not need the complete system as proposed. We feel that the basic elements are the category and the number. There is nothing magical about the shape of the placard on which these items are displayed, and we have recommended an optional approach of using either a rectangular or diamond shaped placard. Those of you involved in highway transportation can readily understand the problem of placing on the front of the cab a diamond shaped placard as would be prescribed. We have also suggested that for national bulk shipments the use of the international symbol is superfluous.

We are aware that the emergency forces have been critical of the present English language approach for warning devices in that the degree of hazard and the presence of secondary hazards are not clearly established. I am not at all sure that the emergency forces will support the proposed system, since I am informed that they do not believe it meets their requirements for immediate identification of the hazards involved and the degree.

I reiterate that this is an Advance Notice. This means that after receiving comments, the Department of Transportation will evaluate these comments and then issue a Notice of Proposed Rule Making for comment from which the final regulations will be derived.

Turning now to some of the dockets affecting motor carrier safety, I am sure that all of you are aware of Docket MC-7, which recently revised the driver qualifications. We now have a pending docket, MC-40, which would mitigate some of the existing disqualification penalties for drivers who are convicted of certain offenses. Many of our people are opposed to this mitigation because it is felt that drivers of vehicles transporting hazardous materials should be aware of severe punishments when convicted of such things as drunk driving, etc. while on duty. The present regulations require offenses committed off-duty to be counted in the disqualifications for on-duty driving. Our members feel that this might be too severe, and have suggested that some consideration should be made, such as a provision that the penalties affecting on-duty driving should not exceed those awarded by legal processes for the off-duty offense. This is a political proposition at present, and the Department appears to be making gestures to appease certain interested parties.

Another item of considerable importance is Docket No. MC-36, whereby private carriers must now report accidents to the Department of Transportation. When this order was issued, the Department raised the limits for a reportable accident to $2,000. This, of course, will eliminate many previously defined reportable accidents and may not be as onerous as had been feared.

Although I said that we rarely comment on proposals of the National Highway Traffic Safety Administration, we have had at least two orders in which we have participated. One of these had to do with the so-called "mini skirts" which were proposed for trucks. Basically, these would be devices to prevent cars from running under the trucks from either the rear or the side. Fortunately, we and others protesting were instrumental in having this proposal recalled. This is obviously an old subject but could be new again any day. I do not believe that this is a dead subject as there seems to be congressional backing for the original proposal as well as backing from some other interested groups.

The other area concerns brakes. One of the newest orders requires anti-skid devices to be mounted on new trucks manufactured after 1974. There are a number of those devices on the market today, and many companies are already using them. However, this will be an expensive installation and will add to the cost of trucks. Although brake requirements are not peculiar to the petroleum industry, we do operate hundreds of thousands of trucks and are vitally interested in proposed changes. New proposals are frequently appearing pertaining to brakes, and I can safely say this subject is going to be new for some time to come.

The Office of Hazardous Materials will answer requests for interpretation submitted by anyone on any part of the regulations. Frequently you will find reference to these interpretations in the OHM Newsletter which is issued monthly. This newsletter usually summarizes the notices and orders issued during that month and comments on certain aspects of the regulations.

Another item which is new in the Department of Transportation is a close-working relationship with the Occupational Safety and Health Administration. A number of OSHA regulations cross paths with regulations of the Department of Transportation, and there is considerable effort being exerted by both of these organizations to insure uniformity wherever possible. For example, OSHA has proposed new definitions pertaining to a flammable liquid and the establishment of a combustible liquid category which is compatible with those proposed by the Department of Transportation. Furthermore, there is excellent liaison, at least on the Washington level, between the Department of Labor and the Department of Transportation by which the gray areas of overlap on regulations are being resolved.

One last item of "what's new" involves a certain number of handouts prepared and issued by the Bureau of Motor Carrier Safety. One is the visual determination required for fire extinguishers. Others include a truck driver's pretrip checklist, instructions for examining physicians, a report of the physical condition of commercial drivers involved in accidents for the year 1970, and a recommended procedure for pretrip inspection of vehicles.

TRAINING + HOUSEKEEPING = SAFETY

By HUBERT M. MILLER
Mgr., Safety, Shell Oil Co., Norco, La.

The following presentation was illustrated by the showing of film slides.-Ed.

How important is Housekeeping?

How important is Training?

I am convinced that each of you, with a dedicated push on housekeeping and training can, with the personnel and equipment you now have, substantially reduce your injuries and fire losses this year. In fact, if you are just average in the N.S.C. figures you can probably cut your accident and fire frequencies in half in one year.

Quite often in quest of a new flashy safety approach or a panacea for safety, our attention slips enough to allow the solid basic program that has been carefully nurtured on experience to falter. I would like to review two requirements of that basic program and how they are used.

Two major building blocks of a sound program must be housekeeping and training. If your housekeeping and training are good, you will have a sound program with visible results.

Training.

Training imparts knowledge of *what* to do and skills of *how* to do. Regularly scheduled and properly conducted meetings must be held. The first cycle should include training directed toward equipment involved with your jobs. For example:

Fire Extinguishers. All of us have some type fire extinguisher. The training should be the actual use of the extinguisher used in the area and preferably near the work area.

Emergency Breathing Equipment. Again, we use the equipment from the area; therefore each person uses his assigned equipment. We find it effective to bring a trailer into the area, set off a smoke bomb or tear gas, and require every one to use his own equipment to enter the trailer.

Fire Hose Handling. In this case we use the equipment installed in the work area, not the imported fire crew equipment. There is usually a space near the work area where a controlled fire can be set.

First Aid. Emergency first aid sessions are conducted by first aid instructors on basic subjects, such as artificial respiration, control of bleeding, and fracture handling.

Basic Skills. The basic skills can cover any subject to promote efficient and safe job skills, such as safe scaffolding practices, hand signals for cranes, work permits, safe use of ladders, safety tagging procedures, and electrical lock-out procedures.

As the training progresses you will work into simulated emergency drills which will put the skills developed into practice.

What do we expect from our training efforts?

1. One of the first benefits noted will be a reduction in unsafe acts committed.
2. Correct execution of job procedures will result in more efficient operations.
3. Confidence in the ability to do the job will be displayed by more persons.
4. The job attitudes will improve areas of willingness and the loss of the "it won't happen on my shift" attitude as each person becomes a contributor to the program.
5. The stimulated thinking will result in idea exchanges on all levels.
6. The company's support of the safety program will be accepted as a way to do business, and not lip service.

Housekeeping.

To be effective, the need for and enforcement of good housekeeping practices must be a routine way of doing business.

Oil Spills. Oil spills should be promptly cleaned up from the standpoint of fire hazards as well as safety hazards. The cause of a spill should be identified and eliminated. If the correction is within the skill of the operator, he should be expected to correct the problem, such as a leaking packing gland, etc.

One of our senior people always declares, "If you don't put the oil in the ditch you don't have to pick it up."

Oil and water spills cannot be tolerated in a strong housekeeping program. The persons responsible should be involved in the cleanup and rerun or properly dispose of the slop.

Painted and Clean Equipment. Painted and clean equipment not only prevents corrosion but can also highlight problems connected with spills or leaks. Problem spots will show up clearly and can be eliminated.

Automotive Traffic. Unauthorized vehicular traffic leaves marks that show up clearly on level, clean and well-cared for unit areas. Any ruts and pot holes should be promptly removed by the area personnel, and the unauthorized traffic corrected.

Clutter. Loose or unnecessary equipment and supplies must be properly stored. This eliminates tripping hazards and promotes efficient operation.

What should you expect from your housekeeping?

1. The number one benefit from housekeeping can be the elimination of unsafe conditions that otherwise might go unnoticed.
2. The attitudes developed in your personnel will be manifested in pride and a proprietary attitude toward their work areas.
3. Good work habits will be developed and will reflect in day-to-day operations as well as during training of new employees.
4. Good housekeeping breeds a better attitude toward operator maintenance.
5. The operator's efficiency will improve with the orderly use and storage of equipment.
6. Many fire hazards will be eliminated with the exclusion of leaks and spills.
7. In emergencies such as civil disturbances or bomb threats, good housekeeping will be a real asset to bomb search and firefighting.
8. One important factor often not considered when a housekeeping program begins is the resulting excellent public relations. Your company stands to benefit in many ways, such as public support for your business in expansion requests, industrial area zoning, and recognition from ecology groups. For example, this year our refinery was awarded the "Conservationist of the Year" award by the Louisiana Wildlife Federation for the most outstanding conservation achievements by a company. Equally important is the fact the company was recommended for the award by a local hunting club that is located on the bayou near the refinery outfall and is largely made up of hunters and fishermen who live in the refinery's neighborhood.

With strong training and housekeeping programs you can expect acceptance of the safety program, less unsafe acts, less unsafe conditions, less fires, less doctor cases, and less disabling injuries. As a result, your total loss picture will improve. The improvement will be in direct proportion to the importance you give the program. On an average program, a 50 per cent or more reduction is not unusual.

NOISE ABATEMENT: A CASE HISTORY

By GORDON J. GOOD
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In May 1970 Sohio completed construction of a major expansion of its Lima, Ohio refinery. Included in this expansion were five major process units—120,000 BPD crude-vacuum distillation unit, 47,000 BPD ultraformer, 20,000 BPD hydrocracking unit, 47, 800 BPD hydrodesulfurization unit and gas plant, 7500 BPD propylene splitter—and associated auxiliary facilities such as kerosene treating, fuel oil dehydration, steam generation facilities and, significantly, a new 250 foot elevated flare stack. The location of the new units was in a relatively concentrated area about 2,000 feet west of the location of the existing units in the refinery.

During design of the new facilities, it was recognized that there was a potential for noise problems. However, because of the lack of basic noise data on process equipment, it has been decided to wait until after the start-up of the new units and then correct whatever problems might be found. A substantial amount of money was set aside for this purpose.

Two other events occurred in the 1969-70 period. The Walsh-Healy Public Contracts Act of May 20, 1969 established guidelines for prevention of employee hearing damage from noise exposure. In 1970 the Williams-Steiger Act, OSHA, adopted these guidelines as standards and made them enforceable.

Start up of the new facilities commenced in May 1970. As the startup of succeeding units was completed and normal operations were achieved, it became obvious that excessive noise levels did indeed exist in the plant. To further identify the problem, a consultant was retained to undertake both in-plant and community noise surveys.

Using the Walsh-Healy guidelines, the consultant identified six major categories of noise sources emitting noise of great enough intensity to warrant abatement measures for employee hearing protection. The major categories were heaters (i.e., process furnaces), air coolers, steam letdown stations, gas throttling, venting, and boiler noise.

Noise levels measured in the surrounding community were compared with so-called noise criteria curves. At no place in the surrounding community was the noise level above NC 45 which, according to the literature, would invite only occasional complaints. The consultant therefore concluded that a community noise problem did not exist.

By September 1970, as the new facilities began to line out and the majority of the startup disturbances were resolved, complaints of refinery noise began to be received with increasing frequency. It was then that we concluded we had a major noise problem to contend with and that perhaps we had better equip ourselves to do test work and begin a noise abatement project. With the advice of our consultant we acquired the necessary test equipment and set up a testing program. The equipment consisted of a portable survey test meter, an octave band analyzer, and a high quality tape recorder, all battery operated and readily portable.

As a first step it was decided to do a new neighborhood noise survey with emphasis on the area from which the complaints had been received. Further investigation also revealed that our safety people (bless their hearts) had done some noise survey work in the community prior to startup of the new facilities. Thus we would be able to make some evaluation of the effect of the new units on the community noise levels.

After a comparison of noise levels observed before and after startup of the new refinery facilities we concluded that indeed there was

a significant increase in the noise in the residential areas and that it was probably due to a source or sources exhibiting a large component of low frequency. Suspect were the new refinery flare and the large process furnaces.

For the sake of continuity, I am going to turn now to our investigations of in-plant noise which were being conducted at the same time.

Although it doesn't take a lot of fancy instruments to locate loud noises—you just have to listen—we did make a rather extensive survey of the new section of the refinery to quantify the noise levels. Those areas where noise was significantly above the OSHA eight hour exposure limit of 90 dbA were:

1. HDS-Sat Gas Plant area—HDS furnace 95 dbA and higher.
2. Ultraformer area—charge heaters up to 102 dbA and higher. Regeneration heater and detailed reboiler furnace both with maximum of about 95 dbA.
3. Isocracker area—two furnaces, the recycle splitter and stabilizer reboiler furnace, had maximum noise levels of about 110 dbA. The recycle compressor area was about 95 dbA.
4. Crude Vac. area—Crude heater had a maximum of 103 dbA; vacuum charge heater a maximum of 93 dbA. In the center of the unit there is a large area of 90 dbA. This noise is a combination of furnace noise, air cooler fan noise, and the noise of the vacuum jet eductor.

It was obvious from this survey that there were several areas in the plant where noise levels were high enough to be a hazard to hearing. The question still remained, however, as to whether operators spent enough time in the noisy areas to endanger their hearing.

This question was largely resolved for the process operators by conducting a noise exposure test program. Using a noise exposimeter we measured the time to which the operators were exposed to noise above 90 dbA during their normal routine. The results of these tests, conducted on 125 men, indicated that in no case did the measured exposure time exceed the allowable. In fact, for most units, the average exposure time in areas greater than 90 dbA indicated that all of this time could have been spent in the loudest area in each unit without exceeding the OSHA exposure limits. However, there were a few areas in the ultraformer and isocracker areas where noise levels would still have to be considered potentially hazardous. We were also concerned that maintenance men might be assigned for several hours in one of those areas and thus might be subject to hearing damage. Finally, in several areas, although noise levels were not dangerous by OSHA standards, they were high enough to interfere with communications. This can be considered a safety hazard.

As a result of this extensive test work we had arrived at two basic conclusions.

1. There was a community noise problem to the extent that noise levels were considerably higher after startup than before. The good neighbor policy dictated that correction was necessary.
2. Although there was little risk of hearing damage to employees, reduction of in-plant noise levels would be desirable to improve communications and generally improve the working environment.

The next question was, what should be done?

You recall that the neighborhood noise surveys indicated that there was a large component of low frequency noises in the offending noise in the community. "A noise like a jet plant" or "like a freight train" were phrases used to describe the noise about which complaints had been received.

Octave band test data taken during the survey and test programs indicated that the sources exhibiting large components of low frequency noises were the larger process furnaces. The new refinery flare, when flaring gas at high rates, was also a source of much low frequency noise. We therefore concluded that our efforts should be concentrated first on reducing noise levels from these sources.

Let's talk first about the process furnaces. After discussing the problem with the several furnace manufacturers who had supplied the process heaters, we found that it was possible to obtain acoustical plenum chambers which could be expected to reduce noise levels by 10-15 decibels. These plenum chambers would be mounted to cover the air inlet

openings in the gas furnace, so as to baffle the combustion noise, but still allow combustion air to enter. Plenum chambers were ordered for eight of the process furnaces in the new units.

All our furnaces are floor fired multiple burner furnaces. Our baffling arrangement prevents straight line radiation of combustion noise to the surroundings through the air openings in the burners. The baffling surfaces are lined with about two inches of fiberglass acoustical insulation held in place by a covering of expanded metal or heavy screening.

The plenum chamber reduced the dbA level from 86.5 to 76.5 at the observation point. The greatest reductions were at the 125, 150, 250, 500, and 1,000 Hz frequency. These were the low frequencies we were worried about in the community noise problem. Noise reductions in these frequency bands were quite large, from about nine decibels at the 125 Hz band to about 20 decibels at the 500 Hz band.

Similar results were obtained for the vacuum charge heater, again measured 40 feet north of the furnace. A reduction in dbA from 85.5 to 78 was realized. Also, the maximum reductions were in the 125 to 1,000 Hz bands, ranging from eight to 13 decibels.

Returning now to the other major source of community noise, the new refinery flare. What should be done about this?

Three basic approaches were considered: (1) modify the flare itself to incorporate an acoustical shield; (2) provide a ground level flare or thermal oxidizer to burn excess gas at ground levels in a unit specifically designed to minimize radiation of noise; (3) eliminate the need to flare gas.

The first alternative was not attractive for two reasons. First, a complete refinery shutdown would have been required to install a new flare tip, since the flare system serviced the entire plant. Second, evidence on similar systems suggested that although some reduction of noise occurred close by, not much improvement was realized at more distant locations.

The ground flare or thermal oxidizer approach was felt to be technically sound but was quite expensive.

As it turned out, the third alternative, that is, elimination of the need to flare gas was the ultimate solution to the problem. A series of control problems had been the basic cause of the excessive gas flaring. These problems were finally corrected and practically all the flaring was eliminated.

The near field effect of reducing the waste gas flaring was also quite dramatic. During the high flaring periods the readings averaged about 74.5 dbA. With the flare out, that is only the pilot burning, the dbA was reduced to about 65.

During the noise abatement program several other smaller noise sources were also treated, primarily for reduction of in-plant noise levels. These were of two main categories; installation of atmospheric vent silencers and application of acoustical insulation. Seven vent silencers were installed, primarily on steam vents. Piping in three locations was acoustically insulated, the major job being insulation of the vacuum jet and its downstream piping on the vacuum distillation tower.

The major question now was, how much good did we do?

First, a look at the effect on community noise. At the Rosedale location, a reduction of about seven decibels on the A scale was realized. We did not achieve prestartup noise levels as we had hoped, but a reduction of seven dbA is quite significant. At the other locations, reductions of one to two decibels were realized. However, these locations had not been as noisy as the Rosedale locations.

We believe that we have achieved our main objective, however, that of satisfying our neighbors. Our conclusion is based on the fact that since completion of the noise abatement program not one noise complaint has been received by the refinery. Please also note that this record includes two summer seasons over a period of about 18 months.

Reduction of noise levels within the plant are also substantial. Although there are some areas where relatively high levels still exist, it is unlikely that we will attempt further noise abatement in these areas at the present time. The liklihood of exposure over eight hours in the 90+ dbA areas is extremely low. These areas have been posted and ear muffs are

required for any extended work in these areas.

As a result of our first real experience in contending with the relatively new field of noise pollution, we feel that we have learned several things.

There is increased public awareness of noise as another form of pollution. Even though there may be no specific noise regulations in a community, the residents seem to be more inclined to bring pressure on industries which are allegedly causing them discomfort. Therefore, in planning for new plants or for major changes to existing plants we must be concerned with our impact on the surroundings. And of course as many of you are aware, more and more communities are enacting noise regulations which specifically limit noise levels at property limits.

Noise level specifications imposed by OSHA are now a major factor in equipment and plant design. The present limits of 90 dbA for eight hour exposure are moderately restrictive in a modern refinery or chemical plant. However, I think there is increasing evidence that the present OSHA limit will be lowered to 85 dbA for eight hour exposure, with corresponding decreases for shorter exposure within the next two or three years. In fact NIOSH standards for new sources are now a maximum of 85 dbA for eight hours.

In direct opposition to these restrictive trends in noise regulations, trends in equipment design and refining process design have been in the opposite direction. For example, rotating equipment is bigger, runs faster. New refining processes operate at higher temperatures and pressures. Although these trends are a result of efforts to achieve increased efficiences and economies in our business, they result usually in increased emissions of noise. We must effect a compromise. Complaints by neighbors and visits by OSHA inspectors will not go away.

The following suggestions may be applicable to minimize future problems relating to noise pollution.

1. Become familiar with noise regulations existent in your community or applicable to your plant. If they do not exist, consider those which have been adopted for other communities. For example, the City of Chicago has recently adopted a noise ordinance which may be copied extensively by other communities.

2. Become familiar with the noise levels which presently exist in the vicinity of your plant. This can be done by conducting neighborhood noise surveys. This information can be extremely valuable, first to establish a comparison with estimated or real noise levels after changes are made to your plant and, second, to establish the noise levels to which your neighbors have become accustomed. Changes disturb people as much as the actual noise levels.

3. Promote the development of noise specifications for your new equipment. Our approach is, in effect, to request two bids for any potentially noisy equipment, one for the standard equipment and one for quiet equipment. We retain the right to final selection.

4. Be prepared to pay more for quiet equipment. Our approach on our next major job will be to purchase quiet equipment for those applications where experience has shown that we can expect problems. However, we will still plan for some after-the-fact noise abatement as well.

In conclusion I'd like to summarize the manner in which we will approach the problems of noise on our next major job.

1. Obtain best available data on noise makers. Much work has been done by equipment suppliers, industry associations, and private companies in the last five years which will permit us to quantify the potential problems.

2. Set vendors' noise level data and evaluate the cost differences in providing quiet equipment originally or as a later "add-on cost."

3. We will select and pay for quiet equipment in very obvious problem areas such as process furnaces, air cooler fans, control valves, and vents as original equipment.

4. We will budget for and expect to need further corrections after startup.

5. We will obtain good background noise data, prestartup, in the surrounding neighborhood areas.

OCCUPATIONAL SAFETY AND HEALTH ACT - MARKETING COMPLIANCE GUIDELINES

By C. H. KLUNICK
Corporate Safety Director, Continental Oil Co., Houston, Texas

The Williams-Steiger Occupational Safety and Health Act of 1970 authorizes the Secretary of Labor to publish as law Occupational Safety and Health Standards which are neither National Consensus Standards (i. e. NFPA-30, NEC) or established Federal Standards. The purpose of this act is to assure safe and healthful working conditions.

OSHA is divided into two major classifications of standards:

1. Interim - which became effective on February 15, 1971 (Revised issue October 18, 1972), based on National Consensus or established Federal Standards.

2. Permanent - new standards or modification to existing standards that will require public notice and hearing.

The OSHA compliance guidelines are basically self-explanatory. The applicable governing regulation for each item has been referenced by number on the survey sheet. All referenced regulations other than National Fire Protection Association (NFPA)–30 are in the appendix of the guidelines. NFPA-30 is used for reference in lieu of Federal Register Section 1910.106. With these guidelines, NFPA-30, and knowledge of state or other local regulations should be used to determine the specific work required at facilities for compliance to the current standards.

The purpose of the survey is to determine the specific work required at each facility for compliance to the current OSHA or other standards. Each question on the form should be answered at the time the survey is made. The probable answer would be *YES, NO,* or *NOT APPLICABLE (N/A).* One of these should be entered on the form for each question to avoid the necessity of a return trip to secure an answer.

It is recommended that the surveyor familiarize himself with the facility and its environment before determining the answers to the questions. Also, a person familiar with the local circumstances, such as the facility manager/operator, should accompany the surveyor during the inspection as this will lessen the possibility of overlooking an item or a misunderstanding.

A survey form for Terminal/Bulk Plants and Service Stations should be followed.

Assurance that compliance to OSHA standards is continually maintained is the responsibility of the employer. Accordingly, procedures must be developed to inspect facilities to assure compliance.

Areas covered include storage and handling of flammable liquids, drainage and water disposal, sources of ignition, fire extinguishers, underground tanks, electrical system, remote pumping facilities, facilities inside, above-ground tanks, stairs, catwalks and walkways, ladders, valves, pipes, fittings, firewalls, drainage, loading racks, offices, warehouses, shops and garages.

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