SAN JOAQUIN VALLEY UNIFIED
AIR POLLUTION CONTROL DISTRICT
COMPLIANCE DEPARTMENT

COM 2135

APPROVED: **Signed** **DATE:** **December 28, 2006**
Jon Adams
Director of Compliance

TITLE: **RULE 4401 – STEAM ENHANCED CRUDE OIL PRODUCTION WELL VENTS**

SUBJECT: **INSPECTION OF THERMALLY ENHANCED OIL RECOVERY OPERATIONS**

OBJECTIVE:

To provide guidance in the application of Rule 4401, Steam-Enhanced Crude Oil Production Well Vents, so that it is applied consistently throughout the San Joaquin Valley Air Pollution Control District (District).

PURPOSE:

To provide inspection procedures and information to insure uniform inspection of steam-enhanced operations.

POLICY STATEMENT:

Steam enhanced production well vents are a potentially significant source of volatile organic compound (VOC) emissions in the valley. It is important to minimize these emissions with uniform and effective enforcement of this rule. District Staff will insure the uniform application of this rule through the use of this policy. The compliance program will include permitting, inspections, and educational outreach.

A background section that briefly describes enhanced oil recovery operations is included in the Appendix 1.

1. EXEMPTIONS

   A. Steam enhanced oil-producing wells undergoing repair and not on production.

   B. The first 100 cyclic wells of a small producer (defined in Rules 4401 and 1020).

C. Up to 40 permitted wells undergoing pilot testing (defined in Rule 4401), if the wells are unsteamed for the previous two years, and if they are located more than 1000' from an existing system.

D. Up to 40 permitted wells more than 1000' from an existing system.

E. Up to 10 wells that are responding to steam from another operator if no contract exists to provide steam and if a well list is maintained.

2. VIOLATIONS

A. Adding more wells or equipment than is specified on the permit to operate (PTO) or authority to construct (ATC).

B. Operating non-exempt thermally enhanced oil recovery (TEOR) equipment without a permit.

C. Operating a permitted TEOR system with less than 99% reduction in uncontrolled emissions.

D. Exceeding the number of allowable leaks as specified in the PTO/ATC or rule.

E. Not repairing a leak within 15-days of discovery (an additional ten days may be applied for).

F. Not keeping a current list of the wells served by the TEOR system. Not keeping records of the dates and wells undergoing steam stimulation.

G. Not keeping records of well production. Division of Oil, Gas, and Geothermal Resources (DOGGR), Form 110 records meet this requirement and are available on line at: http://opi.consrv.ca.gov/opi/opi.dll.

H. Not keeping records of source tests to demonstrate mandated efficiency, although source tests may be waived and are extremely rare.

3. PRE-INSPECTION ACTIVITIES

Inspections will be performed to verify compliance with the rule and PTO/ATC conditions.

Whenever possible, inspections are to be conducted un-announced. Where source coordination is required, make contact, verify safety requirements, and secure permission to inspect.

Check for any ATCs that may be implemented.

Check the PTO/ATC for the number of wells allowed by the system.

The inspector shall check previous inspection reports for wells inspected in the past. Varying the wells inspected will prevent the facility from concentrating their maintenance activity on repeatedly inspected wells.

Inspection equipment will include:

Properly calibrated Eagle or TLV, and
Copies of permits and inspection forms.

Read Method 21

4. INSPECTION SAFETY

Personal Protective Equipment (PPE) recommended for District inspections is as follows:

Hardhat, eye-protection, gloves, steel-toed boots, hearing protection, and a properly calibrated H2S monitor.

Additional safety equipment may be required by the safety policy of the company to be inspected, and their policy shall be followed.

The inspector shall determine that the wells and equipment can be accessed safely. Hazards may include rough terrain, tripping hazards, moving and/or hot equipment and pipes, or unfriendly wildlife. The inspector shall not cross or walk on suspended pipelines to access wells. Wells shall be approached carefully; the inspector shall not walk under the walking beam to get to the wellhead. Pipe and well components are very likely very hot, contain hot liquids under pressure, and probably contain hazardous levels of H_2S. The well pumps are likely moving more than 1000' of steel rods so that a hand, leg, torso, or head will not slow them down appreciably. The inspector shall wear a properly calibrated H_2S monitor while onsite. If the alarm sounds, the inspection shall be stopped immediately. The inspector shall walk across the wind to get out of the flow and then upwind to safety. No attempt shall be made to measure the leak in an area of high H_2S.

TEOR systems contain very hot materials including steam. Especially if vapors are visible or an audible leak is detected, there may be enough steam present to transfer a significant amount of heat into a metal inspection probe. When exposed to steam, an aluminum probe will become too hot to hold before it can be dropped; the inspector shall exercise extreme caution, especially if visible vapors or audible leaks are detected.

5. INSPECTION PROCEDURE

All components that handle the casing gas up to the point that the TEOR gas is blended with crude oil or non-TEOR fuel gas are components subject to Rule 4401. This includes the casing (check around the outside of the casing where it enters the ground), piping, valves, pumps, compressors, vessels and other components that collect, control, store, or dispose of the non-condensable gas.

The rule exempts wells that are "undergoing service and repair" from the leak checks. The rule defines these wells as those that have a workover rig in place, and these wells should not be checked or approached. In addition, a facility may isolate wells from the system by closing the casing vent valves. In that case, only the casing and the valves should be inspected for leaks. However, if the rest of the TEOR system is active, all of the system components are subject to leaks, even those adjacent to an isolated well.

Permit conditions may add additional items to inspect such as stuffing boxes, which have been added on newer ATCs even though they are exempt under Rule 4401. If the leak rate including stuffing boxes exceeds the rule, the facility shall be in violation of permit conditions.

If an operator finds a leak the rule requires they affix a tag. If the District finds a tag, verify that the date on the tag is not older than 15 days if the well is still leaking. The facility may apply for a ten-day extension to repair a leak, but the extension must be approved. The facility shall be cited if the leak has gone un-repaired beyond 15 days, or 25 days with an approved extension. If the inspector verifies that a tagged component is leaking, it should be added to the inspection count.

Verify that the facility has a current listing (as is required by the rule), and determine the number of wells hooked up to the system. The number of wells will be used to determine if the facility is operating below the permitted well limit, and will determine the minimum number of wells that should be inspected.

Inspect 10% (or no less than 20 wells) of the wells served by the system. In addition, inspect all of the compressor stations or "fin-fan" units.

Depending on the number of wells connected, the facility is allowed a certain number of leaks (see Section 5.3). If the wells number more than 500, the facility is allowed 1 leak for each 20 wells tested with a minimum of 50 wells tested.

For the wells chosen, inspect all accessible casing and TEOR components up to the point where the TEOR gas material is blended with the production stream or is disposed. Be sure to include the casing vent valves, casing flange, and the area between the casing and the earth. If the permit requires it, include the well stuffing boxes in the inspection. At the compressor stations, include all accessible components that carry the TEOR material and especially any pumps and compressors.

After checking 10% of the wells (20 wells minimum), calculate a leak rate to estimate whether the facility is likely to be in compliance if all the wells were inspected. For example, for a facility with 92 wells, Section 5.3 allows 8 leaks. If 3 leaks are detected by checking 20 wells it is likely that the facility will exceed the leak rate. Additional wells should be inspected until the leak rate is exceeded, compliance is clearly indicated, or all the wells are checked. In the opposite case, if one leak is found by checking 20 wells, compliance is likely and the inspection is complete. No calculation is required if the facility exceeds the number of leaks allowed at any time during the inspection; the facility is in violation.

Inspections are to be conducted according to EPA Method 21 Leaks are to be checked at the potential source. The exception is where safety hazards or equipment damage may result from contact with rotating equipment. In these cases, the sensor probe shall be positioned within 1 cm of the source. Leaks are defined as a reading above 10,000 ppm VOC.

The inspector does not have to record the number and type of components inspected; only the wells (Lease and Well Number) and other equipment checked (such as fin-fans and compressor stations). Because any leaks will have to be re-inspected, the inspector shall carefully record the location of any leaks including component type, location, well or equipment number, and lease or property name. The inspector shall show all leaks to the company representative.

Multiple leaks on a single well count as multiple leaks under the rule.

Transfer this data to the appropriate inspection forms.

6. POST INSPECTION ACTIVITY

A. Record Review

Operators are required to keep records of the wells tied to the system, the production from the wells (DOGGR Form 110s will suffice), and records of source tests performed. These records should be examined as part of the facility inspection.

APPENDICES:

1. Background on enhanced oil recovery methods

   Most oil produced in California is very heavy crude (API gravities 12°-14°). This oil is very thick and cannot be brought out of the ground to any high rate of recovery without lowering the oil's viscosity. Different methods are used to the lower the viscosity, including dilution of the oil with gas, detergent, or solvent, and application heat. Heating the oil with steam is the most common technique in use. Most steam is produced by steam generators (see inspection policy for Rule 4306); other facilities utilize turbine engines (see inspection policy for Rule 4703). The systems that use heat to reduce oil viscosity are known as thermally enhanced oil-recovery operations (TEORs).

   Start-up and smaller operations, may apply steam to regular oil wells on a periodic basis. The wells are taken off of production and are injected with steam for a period of time. The wells are allowed to "soak" and then put back on production. These wells are referred to as "cyclic" wells or "huff-and-puff" operations.

   In contrast, most large and long-term operations utilize dedicated steam injection wells that are drilled in specific locations in order to let the steam push the oil into nearby producing wells. These operations are referred to as "steam drive".

   In addition, nearby wells from the same, or other, operator's facility may be affected by a steaming operation, particularly a steam drive system on an adjacent property. Rule 4401 defines a steam-enhanced well as one in which the oil temperature has been raised by steam injection. It is possible that an operator adjacent to a significant steam flood may be affected and is subject to at least the exemptions in Rule 4401.

   Heat lowers the viscosity of the oil and makes it easier to produce so that the company can increase production rate and ultimate recovery. The heat also drives off volatile components and facilitates the creation of H_2S gas. The purpose of the inspection is to insure that the facility is meeting the rule-mandated 99% control efficiency of the VOC control system.

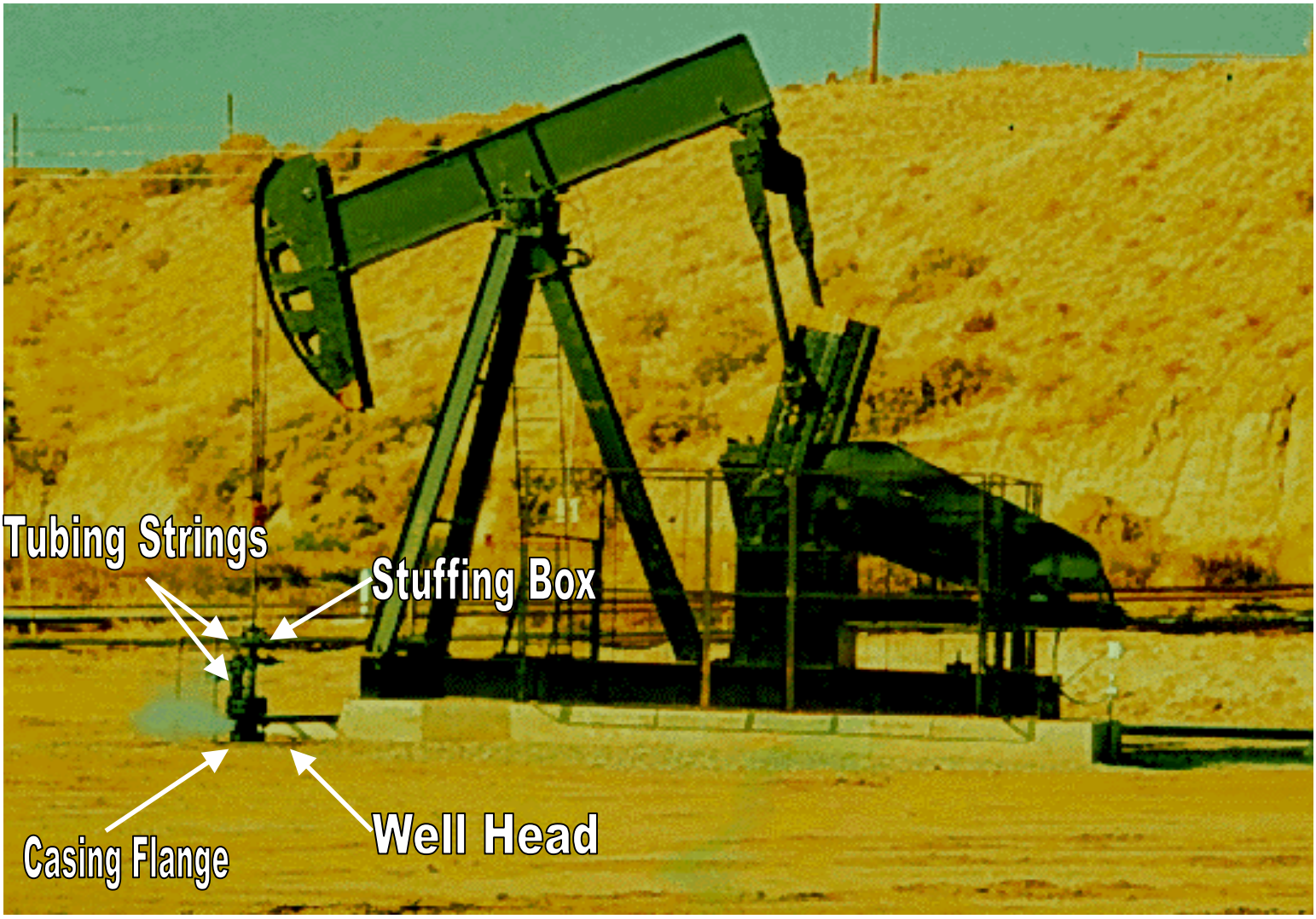
   A typical oil well consists of a hole drilled to the oil-bearing formation and completed with inner and outer strings of pipe. The inner string is known as the "tubing" and includes the down hole pump. The tubing (roughly 3" diameter) is surrounded by the "casing" (roughly 8" diameter) that is usually

cemented into the production zone. Produced oil is moved by the well pump through perforations in the casing and up the tubing to de-hydration and storage. Gas produced by the heated oil are present in the annular space between the tubing and casing. This is the gas that require control by Rule 4401. The tubing is connected to the center of the wellhead and contains the "sucker-rods" that actuate the down hole pump. The casing stops at a large-diameter flange that is near-ground-level. The casing is typically equipped with two valves located on the upper end of the pipe, just below the flange. These valves control the casing "vents". Refer to attached pictures (courtesy of California Air Resources Board Class #261).

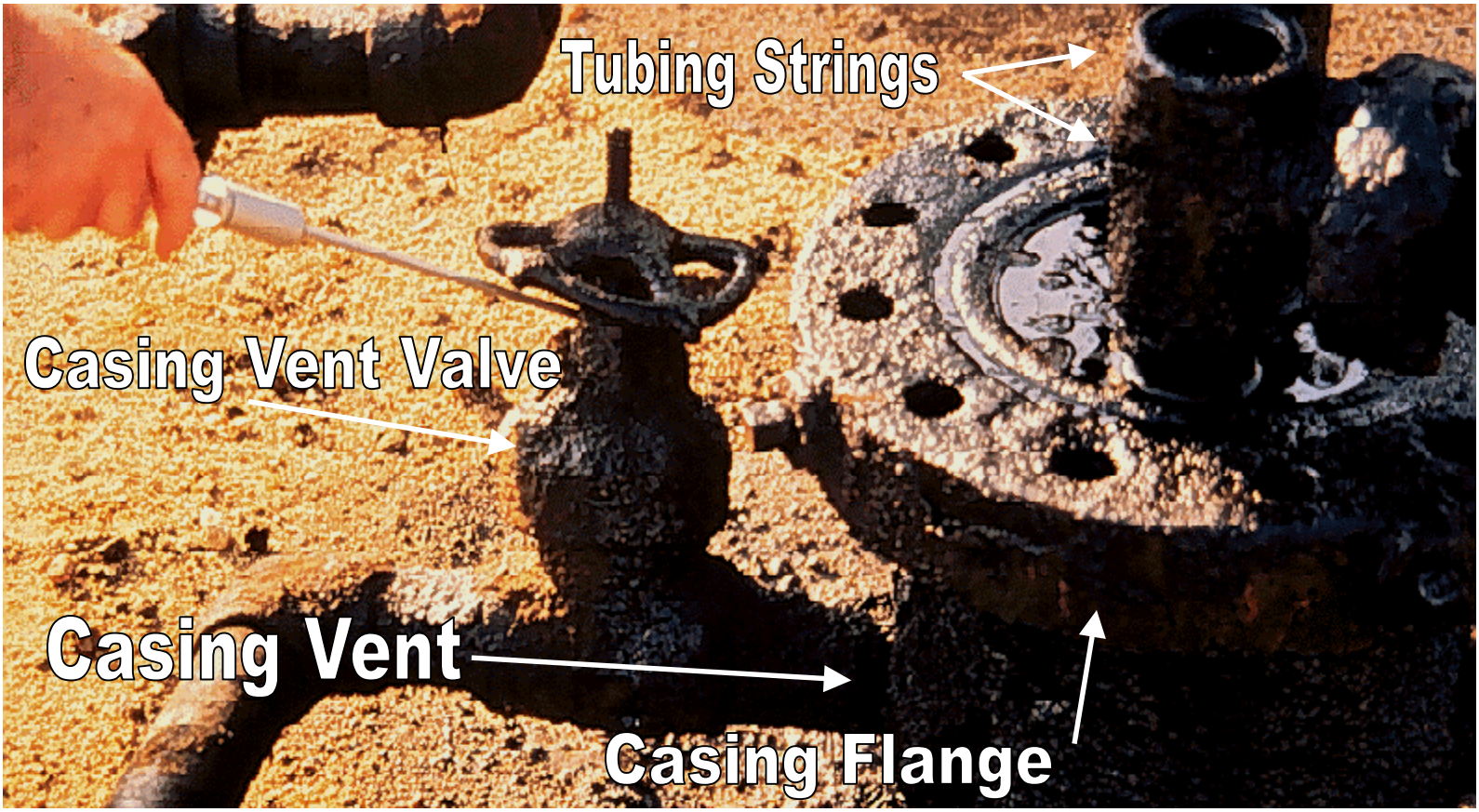
In an **active** system, the casing vents are connected to a series of pipes, vessels, pumps, coolers, and compressors that collect, cool and move the non-condensable gas to some sort of control device. The most common control is a steam generator that burns the casing gas in addition to regular fuel. The disadvantage of this approach is the cost to build and maintain the system. The advantage is that the pressure at the production zone is lower and production should be greater.

In a **passive** system, the casing vents are closed and the gas is not moved or recovered directly. Once a certain pressure is reached, the casing gas will remain in solution with the oil and will end up in the storage tanks. This is not allowed if the tanks are not under some sort of vapor recovery. A modification of this method uses an existing TEOR system. The casing vents are open to the TEOR but the system is not actively pulled. An equilibrium pressure is established between wells. These "balance" systems require less maintenance except that they must send oil to tanks equipped with a vapor-recovery system. The facility must be permitted to use the TEOR system as a balance.

For all systems, all piping and fittings attached to the casing vents up to the point where it joins a non-TEOR gas line or a production line are subject to this rule.



Typical pumping unit and well head.



Typical well head with casing vent and vent valve. The casing in the large-diameter pipe below the flange.