
# TRIMETE0R ENERGY

# Frequently Asked Questions

Trimeteor Energy ("Trimeteor" or "TOG") has assembled a list of frequently asked questions to which answers have been provided to aid the investor and potential end-user in further understanding the benefits of a superheated steam supply system in the upstream oil business. The following FAQs cover various subject materials pertaining to the technology, production, and operation of TOG's QUAD-S as it is utilized in a downhole oil well configuration. The answers provided clearly reflect Trimeteor's VISION that is highlighted below:

> ***"Trimeteor is committed to providing a technological solution to the obstacles encountered in the extraction of heavy oil and increasing production of marginal and stripper wells. The industry has long sought a low cost, efficient means to tackle these two areas and we believe Trimeteor's patented Superheated Steam Supply System, the QUAD-S, will set the standard and become the dominant technology for the development of heavy oil reserves and revitalization of marginal fields. We have accepted the challenge to capture and tame this very lucrative market, and move America closer to achieving energy independence."***

 


# TRIMETEOR ENERGY

## Frequently Asked Questions

**Question 1: Steam generation has been around for 100 years and the major oil companies have it down to a science. So how is it that a newcomer to the oil and gas business has recognized the benefits of superheated steam in the oil fields?**

TOG management believes that it is not uncommon for those highly invested in a long used technology, such as a saturated steam system, to be skeptical about and resistant to change. Solving the same problem from a fresh set of eyes and from those with a diversified experience base, as exhibited by the TOG management, often times produce revolutionary technology. Furthermore, the availability of advanced, high-temperature-resistant materials of construction has made the Trimeteor technology possible in the last several years. *"To say that we have not met with some resistance from those invested in conventional Enhanced Oil Recovery would be a misstatement…and that's okay. If memory serves me right, the industry experienced the same reluctance when steam was first introduced into the oil fields in 1959 (approximately 55 years ago), and the first horizontal well drilled in Texas in 1929 and in Pennsylvania in 1944, with little practical application until the 1980s." - Richard B. Graibus, CEO and President, Trimeteor Energy*

**Question 2: What makes the TOG QUAD-S technology different than conventional steam flooding?**

There are three significant differences between the QUAD-S technology and a conventional steam flood. First, the QUAD-S is designed to be inserted in a production well without the need for non-oil producing injection wells. Second, the QUAD-S technology creates and delivers downhole steam temperatures far in excess of those available to saturated steam systems, thereby permitting the quicker heat transfer from the dry steam to the target oil reservoir. Third, the QUAD-S technology has both a latent heat packet (of 972 btu/lb of supply water) AND a heat packet of sensible heat on the order of that also provided by the latent heat of vaporization. This is TOG's "2-for-1" advantage on a pound for pound basis. That is twice as much available heat per pound when compared to a conventional steam flood (or any other saturated steam supply methodology)!

 


## Question 3: So what do you do if you don't steam flood and how would the steam be pushed back into the formation to do any long term good?

Trimeteor's QUAD-S technology is designed to generate AND deliver high temperature (900°F - 1600$^{o}$F) superheated steam using substantially less supply water than conventional steam methods, including, but not limited to conventional steam flooding techniques. The reservoir fluids are immediately (relatively speaking) affected whereby the viscosity of the crude oil is significantly improved thereby permitting heavy oils, which previously were almost impossible to flow, to be pumped to the surface in the same production well where the QUAD-S piping is installed. There is no waiting for days or months for essentially a hot water volume to push or displace other liquids to a distant production well. Simply put, the Trimeteor QUAD-S superheated steam supply system relies on the superior heat transfer mechanisms to enhance the reservoir fluids viscosities and distill the lighter fractions in the oil reservoir. The long term effect on the reservoir is achieved by a continuous injection of superheated steam as opposed to the intermittent delivery of a liquid-vapor mixture common to all saturated steam supply techniques commonly in use today.

## Question 4: How do you drive the oil to the production well?

The QUAD-S does not use steam drive or water flooding to "drive or push" the oil as in conventional steam methods. The superheated steam approaches the reservoir formation from the production well bore, displacing the oil/water in the formation by vaporizing the reservoir water and lighter hydrocarbons, resulting in an **increase in the reservoir drive mechanisms**, significantly and immediately reducing the oil viscosity, and increasing the speed of capillary flow, thereby “wicking” the reservoir oil toward the production well pump.

## Question 5: What is superheated steam and how does it react in a production well?

Superheated steam is a gaseous state of $H_2O$ that is liquid free (i.e., dry) and that has a tremendous heat capacity for doing thermal work. Quite often, to describe the level of superheated steam, it is described quantitatively as having so many degrees of superheat, which signifies the number of degrees Fahrenheit (or Celsius) that the steam temperature is ABOVE the saturation temperature for the given temperature and coincident pressure. The higher the number of degrees of superheat, the larger the margin whereby the gaseous state will continue to exist even while giving heat off to the surrounding environment (i.e., the oil reservoir in the case at hand). Superheated steam has the same heating capacity of saturated steam **PLUS** approximately 1 BTU/lb per degree of superheat! For the QUAD-S steam delivered downhole, this amounts to approximately <u>twice as many BTU/lb as the same mass of saturated steam</u> delivered down an injection well!

 


## Question 5: What is superheated steam and how does it react in a production well? (Continued)

In addition, superheated steam cannot condense (i.e., creating the presence of liquid water) without its temperature being reduced to the temperature of saturated steam at the pressure of interest. As long as the gas temperature is above that of saturated steam at the corresponding pressure, it is in the superheated regime and before condensation is possible, the number of degrees of superheat must vanish through some method or combination of methods of heat transfer (i.e., conduction, convection, and radiation).

So by virtue of its physical and thermal properties, the QUAD-S superheated steam, when compared to conventional steam at the same pressure, **will travel further into the formation at temperatures and velocities that far exceed conventional saturated steam.** Finally, as a result of the heat transfer mechanisms involved, the TOG QUAD-S superheated steam can deliver a larger heat envelope deeper and quicker into the reservoir formation than conventional steam.

## Question 6: Is there a significant loss of heat in surface transmission and down the well bore?

The short answer is no. Due to the superheated steam velocity (due to initial higher temperatures at the wellhead) and the resistance of the superheated steam to give up heat to the steam pipe wall, relatively little heat loss occurs downhole until the superheated steam begins to mix with the reservoir fluid and formation.

## Question 7: How does the superheated steam achieved by the QUAD-S compare to other steam producing plants and components?

Let’s review a clear comparison to the superheat of three other forms of steam producing plants and components. As the sensible heat that is available over and above that at the saturation temperature (and associated pressure) is a direct function of the number of degrees of superheat, at 1200$^{o}$F, the number of degrees of superheat for the QUAD-S is in excess of 914°F as compared to a subcritical fossil fueled boiler at 369°F; a commercial nuclear power plant at 33°F; and commercial steam genie, operating at saturation temperature, thereby providing literally ZERO superheat. The number of degrees of superheat is the difference of the operating temperature of each system MINUS the respective saturation temperature at the coincident pressure that each system operates. Furthermore, it can be deduced that the QUAD-S operating at 1200°F to 1600°F with a saturation temperature of 286°F produces 914$^{o}$F to 1314$^{o}$F of superheated steam. Any increase in the

 


### Question 7: How does the superheated steam achieved by the QUAD-S compare to other steam producing plants and components? (Continued)

operating temperature does not change the saturation temperature, but will result in an even larger heat capacity as a result of an increase in the number of available degrees of superheated steam.

### Question 8: At what pressures does the QUAD-S operate and how does that compare to conventional steam and other steam plants?

The comparison of the same types of steam systems identified in Question 7 is made with respect to the operating temperatures and pressures. Quite significantly is the relatively low operating pressure of the QUAD-S, which is taken to be 40 - 100 psig as compared to the commercial steam genie at approximately 135 psig; the nuclear power plant in excess of 900 psig; and the subcritical fossil fueled boiler at approximately 2500 psig.

### Question 9: Is the QUAD-S really just another way to do a routine hot-oil treatment?

While "hot oil treatments" are an acceptable method of deparaffinization, no treatment fluids are needed using the QUAD-S to rescue a well from the production-slowing effects of paraffin. It quickly becomes evident that the ecological impact of that fact is a plus whenever chemicals or additional petroleum products can be avoided both during the remediation and oil production process.

### Question 10: Does one then expect that with the superheated steam being a pure gas that there is more penetration into more of the formation than with current steam technologies?

The short answer is yes. The thermal inertia associated with superheated steam allows for greater penetration without the mechanical drive mechanisms associated with higher pressures and without the undesirable structural degradation of the formation.

### Question 11: Can the QUAD-S technology remedy steam override or at least lessen its effects?

Yes, the effects of steam override are anticipated to be lessened. When an oil reservoir is subjected to conventional steam injection, steam tends to move up in the formation and condensate and oil

 


## Question 11: Can the QUAD-S technology remedy steam override or at least lessen its effects? (Continued)

tends to move down due to the mass density differences between the fluids. Gradually, a steam override condition develops, in which the injected steam sweeps the upper portion of the oil zone, but leaves the lower portion relatively untouched. Injected conventional steam will tend to follow the path of least resistance from an injection well to a production well. Areas of high permeability will receive more and more of the injected steam, which further raises the permeability of such areas. This phenomenon exists to an even larger degree with low conventional steam injection rates and thick formations. The steam override problem worsens at greater radial distances from the injection well because steam flux decreases with an increase in steam zone radius.

The steam override condition described above refers to the use of an injection well and describes steam drive or steam flooding. **The TOG QUAD-S technology does not require an injection well** and it is believed that this fact will assist in partially mitigating the effect of steam override at the production well. The QUAD-S delivers superheated steam at temperatures up to 1600$^{o}$F down the production wellbore allowing the number of degrees of superheat to be well in excess of 900$^{o}$F plus. Additionally, tests performed by others in Kazakhstan revealed a larger effective steam radius with superheated steam, again, using only an injection well, even though the degrees of superheat varied between 50$^{o}$ - 158$^{o}$F using 450$^{o}$F as the saturation temperature, which is substantially less than that produced by the TOG superheated steam supply system!

## Question 12: What is the particular reservoir type and oil recovery process to which TOG intends to apply low pressure superheated steam?

Trimeteor's QUAD-S does not assume a particular type of petroleum reservoir nor a particular oil recovery process. However, the QUAD-S does provide a very significant number of degrees of superheat per unit mass that may be utilized in a variety of enhanced oil recovery applications.

## Question 13: Is TOG envisioning thermal soaks using conduction to get the heat to the formation since the accompanying low pressure will not allow steam to enter the formation?

TOG is not envisioning thermal soaks per se, as a soak implies a delay time involved between the time steam is injected and the oil is pumped to the surface. In addition, thermal soaks rely predominantly upon the conduction mode of heat transfer, which in general is a very slow heating

 


## Question 13: Is TOG envisioning thermal soaks using conduction to get the heat to the formation since the accompanying low pressure will not allow steam to enter the formation? (Continued)

process in comparison to either convection or radiation heat transfer. The QUAD-S smartly utilizes the production well whereby the steam piping is installed and the delivery is relatively immediate to the reservoir fluid through predominantly the convection mode of heat transfer. The large temperature difference between the superheated steam and the reservoir fluid creates flow and a release of heat to the reservoir and surrounding formation.

## Question 14: What effect does the QUAD-S have on the water-cut, if any?

During Trimeteor's testing of the QUAD-S in Wyoming at LAK Ranch on a well with a water table/oil cap and depletion from water flooding, the QUAD-S increased the oil cut to 27% the first month, 14.7% the second month, and 16% the third month up from an average of 9.2%. These results are consistent with published results by others utilizing superheated steam in enhanced oil recovery.

## Question 15: What is the physical footprint required by the Trimeteor superheated steam supply system (QUAD-S)?

The QUAD-S requires only a 9 ft. x 20 ft. footprint for the module structure that is only 9 ft. in height, or 180 $ft^2$.

## Question 16: What infrastructure must be in place or is required by the end user to utilize the QUAD-S?

The QUAD-S requires only a water supply capacity of approximately 25 barrels per day (from any number of possible choices) and an electrical source from either a fixed or portable delivery system capable of powering the unit with 480 volt, 3 phase electricity. In addition, the QUAD-S outlet piping should be capable of being positioned within 20 ft. of the production oil well.

## Question 17: How is the QUAD-S fabricated and by whom?

TOG specifies and manages the design, procurement, fabrication, inspection, and testing of all components and sub-assemblies that comprise the superheated steam supply system. Most if not all of the components utilized in the final assembly of the system meet the respective requirements


### Question 17: How is the QUAD-S fabricated and by whom? (Continued)

of numerous national consensus codes and standards such as the ASME Boiler and Pressure Vessel Code, OSHA, NFPA, ASTM, IEEE, Underwriters Laboratory, and a host of others. The subsystems are produced by highly qualified supply-chain partners in conjunction with TOG engineering and commercial oversight. In some instances, the TOG supply chain partners have met additional internationally recognized certifications such as ISO quality standards and production discipline, insuring performance and reliability of the final assemblies. Once fully assembled, the QUAD-S module undergoes final functional testing prior to shipment to the end-user.

### Question 18: How quickly can a TOG QUAD-S unit be produced?

Once the appropriate inventory levels are achieved, the production rate is planned to be less than 2 weeks, which includes assembly, testing, and shipping from Las Vegas, NV.

### Question 19: How much maintenance is required?

The TOG QUAD-S is designed to minimize maintenance and downtime to the maximum extent possible. The units are further designed to provide continuous steaming for months between routine outages for wear item replacements.

### Question 20: Is the TOG QUAD-S process dangerous?

The TOG QUAD-S process fluid is a high energy system that is contained within piping and pressure vessel components that employ state-of-the-art high temperature service materials of construction. While the stored energy is significant, precautions have been taken to safeguard operators and service personnel through the use of components that meet and exceed the appropriate National Consensus Codes and Standards, thereby minimizing the “danger” associated with high heat containing processes.

### Question 21: How much heat can be delivered to the reservoir?

The maximum temperature of the superheated steam delivered to the reservoir is 1600°F. At a water supply rate of 36 gallons per hour (gph), that equates to approximately 540,000 BTU per hour per module. This heat rate can be adjusted to meet the customer and particular reservoir demands.

 


## Question 21:  How much heat can be delivered to the reservoir? (Continued)

The final estimate of the absolute heat is dependent primarily upon the mass flow rate, the depth of the production well (which affects the heat loss as the steam travels downhole), and the inside diameter of the steam piping within the production casing.  Ultimately, the desired amount of total heat delivered downhole can be varied to suit the particular needs of the reservoir or well characteristics.

## Question 22:  What are Trimeteor's estimated costs and how can the QUAD-S compete with conventional gas-fired steam generators?

At a water supply rate of approximately 36 gph and an assumed water supply temperature of 70°F, the mass flow rate is approximately 300 lb per hour resulting in the QUAD-S supplying in excess of 540,000 BTU/hr. of 100% quality steam at 1600°F.

Utilizing the electricity cost of $0.04 per kW/hr., the QUAD-S can be expected to run at the previously defined parameters at a competitive cost of approximately $8.73 per MMBtu.  Note that this value assumes the heaters are at the maximum heat output values and consuming the maximum electrical energy.  To date, the TOG field data has shown that the energy consumption has been only 84% of the theoretical value defined herein.  If one factors in the field data, then the expected energy costs is only $7.33 per MMBtu.  Based upon the natural gas costs data available from others, this puts the QUAD-S in a very competitive position before considering the numerous qualitative advantages that the electrical heating sources have over natural gas, nonetheless of which includes the exclusion of flammable gasses on site.  Furthermore, the current conventional saturated steam systems do not have the advantage of superior ultra-high temperature delivery to the well bore.

## Question 23:  What's your SOR (Steam to Oil Ratio)?

The steam-to-oil Ratio (SOR) is a metric used to quantify the efficiency of oil recovery processes based on types of steam injection.  Typical values are 3 to 8 for cyclic steam injection and 2 to 5 for SAGD.  This means that 2 to 8 barrels of water converted into steam is used to produce one barrel of oil.  The lower the SOR, the more efficiently the steam is utilized and the lower the costs.  The

 


## Question 23:  What's your SOR (Steam to Oil Ratio)? (Continued)

current test data to date indicate that **the TOG QUAD-S has an SOR no greater than 1.0**!  This value clearly indicates a significant improvement over other conventional steam technologies in the measured efficiencies of the superheated steam supply system developed by Trimeteor Energy.

## Question 24:  Why does the superheat temperature not melt casings and cement in wells?

The superheated steam is isolated from the surrounding casing and outlying cement in its own specially designed high temperature resistant piping.  While there is some heat transfer from the outside surface of the steam piping/tubing inside of the casing annulus, the vast majority of the heat remains within the process fluid (i.e., the superheated steam), which keeps the casing pipe and surrounding cement well within acceptable working temperatures for the respective materials of construction.

## Question 25:  What are the chances of the competition from the oil and gas industry to come out with a different design (away from Trimeteor patents) of producing superheat to compete and destroy the business model plan of Trimeteor?

First let's talk about the industry's resistance to change.  It is not uncommon for those highly invested in a proven technology to be skeptical about new technology or technology with a “different twist” from that which is termed “conventional.”  First, some of the other players in the oil and gas service sector don't fully understand the intricacies surrounding very high temperature heat transfer processes and the material challenges associated with the QUAD-S.  Secondly, others fall back on comparing the TOG QUAD-S to conventional steam methodologies currently in use, which the TOG patented process in no way resembles.  As found on the TOG website, *"To say that we have not met with some resistance from those invested in conventional Enhanced Oil Recovery would be a misstatement…and that's okay.  If memory serves me right, the industry experienced the same reluctance when steam was first introduced into the oil fields in 1959 (approximately 55 years ago), and the first horizontal well drilled in Texas in 1929 and in Pennsylvania in 1944, with little practical application until the 1980s."  [Richard B. Graibus, CEO and President of Trimeteor Energy]* So if history repeats itself, and TOG has no reason to believe otherwise, it will take years before the industry foregoes the billions it has invested in conventional steam technology and entertains the benefits of superheated steam.

 


## Question 26: How confident are you that the loss of integrity of the superheated steam generators is under control and that there is an acceptable useful life of the subject pressure vessels?

The structural integrity of the TOG superheaters is assured to the maximum extent possible through the entire process by utilizing state-of-the art national consensus Codes and standards in combination with recognized experts in the field of mechanical engineering. The superheaters are pressure vessels that are designed, fabricated, tested, and inspected in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME B&PV Code). In addition, the materials of construction are high temperature materials that are approved for use in the temperature ranges required by the TOG QUAD-S and that meet or exceed the specifications contained within Section II of the ASME B&PV Code. Finally, TOG's Chief Technical Officer has over 40 years' experience in the design, analysis, and fabrication of pressure vessels and piping utilized in the refinery, petrochemical, and nuclear industries, all of which employ numerous ASME B&PV Codes consistent with their respective industries.

## Question 27: Is superheated steam safer than the saturated steam (and liquid water) most commonly utilized in thermal delivery systems in the presence of any volatile petroleum fractions that may be found in downhole reservoirs?

The presence of volatiles may presume that combustion be a potential hazard that must be considered at the higher delivery temperatures associated with the superheated steam process. In the case of the lower temperatures associated with saturated steam systems, the potential for combustion of any volatiles is no less probable due to the fact that in both cases, sufficient oxygen must be present in the correct volumetric ratios to sustain any combustion downhole. In fact, there are other competing technologies that actually deliver oxygen containing gases downhole in combination with a thermal drive mechanism whereby the end result is a mixture of hot combustible gases and steam. Ultimately, the chance of an undesirable burning of volatile gases downhole without the purposeful additional of oxygen containing gases is not considered to be any more likely with the higher temperature superheated steam process employed in the TOG QUAD-S than any other high temperature thermal drive mechanism or system.

 