Infrared Thermography for Stationary Marine Applications

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Abstract

Infrared thermography is widely used for PPM applications of commercial and industrial facilities throughout the world. Thermography is also used on electrical and mechanical systems for many types of marine applications. Most marine applications pertain to mobile or moving vessels such as cargo ships and dredges. A lesser known application for thermography involves stationary marine systems. Stationary marine systems are structures or vessels that are not supported by land, are not mobile, and are permanently moored. This paper will discuss the techniques for applying thermography to stationary marine structures and systems along with the challenges, logistics, and safety issues particular to this application.

Discussion

One of the most distinguishing points any contractor performing marine thermography must face is the necessity to carry marine type insurance coverage and liability. This is true for all marine type applications including those for stationary type structures and facilities. This makes an interesting fact that not any contractor performing thermography can legally perform inspections on these types of stationary marine systems. The reason for this is because of a maritime law known as the Jones Act.

The Jones Act is a law specifically governing any type of work on any marine structure or vessel. The Jones Act basically states that once you leave land and board a marine structure or vessel of any type not supported by land, a whole new world of legal liabilities, ramifications, and actions exists. Maritime worker's compensation and liability insurance policies are completely different and separate from those types of insurance policies that land-based contractors are required to carry. The companies that actually issue and supply these types of policies are limited in number. These types of policies are typically more expensive to purchase than normal liability policies. The elevated cost of these types of policies is one of the reasons that the number of marine type service companies is limited in number.

On the other hand, it is also one of the reasons that thermography rates for marine related work are usually elevated as compared to land-based thermography rates. Many service companies are able to circumvent purchasing and carrying these types of insurance coverages and still perform some marine work by working as a sub-contractor for a company that does have the proper coverages. This thermographer would strongly urge any companies asked to perform marine work to investigate the requirements needed to legally board and carry out any type of work on any marine structure or facility.

Although the monetary gain may seem attractive because of elevated service rates, an accident or improper action could be catastrophic to the company or individual performing the work. I have personally seen companies and service personnel put themselves at monumental risk by not having the proper required coverage just to make a small financial gain. These insurance and liability issues are just one of the many different factors that face a marine thermographer on an everyday basis.

Now, on to some of the most typical stationary marine thermography applications, logistics, safety issues and potential problems that are all an interesting part of stationary marine thermography. There are basically two typical types of stationary marine facilities serviced by thermography on a regular basis. The first, and by far the most frequent type, is offshore oil and natural gas production platforms. These are stationary platforms that are moored to the ocean floor, often many miles from land. These platforms are used to drill and recover oil and gas from the ocean bottom in water depths ranging from many feet to many miles. The second type of facility pertaining to stationary marine thermography is permanently moored gambling boats, also known as riverboat casinos. Riverboat casinos are available to board directly from land, but are still floating or supported by water. It is for this reason that these are still considered a marine-type application of thermography.

Both of these stationary types of marine facilities and structures are very popular in the Gulf South region of the United States and are those typically serviced by this thermographer. Both of these types of stationary marine structures have their own special challenges and features when it comes to performing thermography. We will now begin to cover some of the similar and different aspects of performing thermography for these types of applications.

The first stationary marine application we will talk about is stationary offshore oil and gas platforms. These platforms are known and referred to by many simply as oilrigs. For the purposes of this paper, from here on out, when offshore platforms are referred to as oil rigs it needs to be understood that they are one and the same.

Oilrigs are of two major types: the stationary, or fixed, location rigs and the movable jack-up rig. For the purposes of this paper we will limit the coverage to that of the stationary oilrigs. The stationary oilrig is, as the name says, stationary. It is put on location and anchored or moored to the sea bottom using various methods. Many times these rigs will never be moved again even if they become unproductive. These rigs can

remain active and on location for years or decades once on a productive site. These are rigs that drill for oil and gas under the ocean floor in water depths from feet to miles. Not only do they drill in various water depths, but they also drill at varying depths into the ocean floor. Sometimes the total drilling depth between the water depth and the ocean floor depth can be tens to hundreds of miles. In many cases, the application of thermography and safety concerns are very similar to that of typical land-based thermography. There are, however, many differences in logistics, scheduling, applications and safety concerns that make this type of thermography interesting.

One of the most interesting and adventurous differences in performing thermography surveys for stationary oilrigs is the scheduling to perform the job. Many times, getting these jobs scheduled can be a logistical nightmare. This is because the travel to and from these rigs can be very difficult and time consuming. As one can imagine just by the name itself, offshore oilrigs, these rigs are generally located somewhere in the ocean or sea. These rigs can be anywhere from several miles to hundreds of miles from the nearest land. It is not at all like driving into a plant or up to a commercial facility of some type and simply walking up to the starting point of the job. It is one of the most drastic differences that a land-based thermographer who has never done this type of work must face. It is for this reason that the scheduling of and traveling to the job to perform the work is an interesting and challenging experience.

There are two basic modes of transportation for traveling to and from a job on an offshore oilrig. The type of transportation used is usually up to the client and is also at his/her discretion. The first mode of transportation widely used to travel to and from these oilrigs is high-speed personnel carrying vessels or boats known to the industry as crewboats. These crewboats can generally vary in length from 30 to 60 feet and are typically diesel powered. These boats carry personnel to and from the rigs ranging from single digits to tens of people.

Since these crewboats are typically operated by a third party company, and are not owned or operated by the same company as the oilrig, it can often throw another clog into the scheduling procedure for this type of work. Many times, the oilrig's owner will have the service technician contact the Crewboat Company to try and schedule a trip, and this becomes another scheduling nightmare. The crewboat rides to and from these oilrigs can range anywhere from minutes to hours.

This is one of the reasons why we in the industry of performing service offshore say our golden rule is never be late for the departure time to a rig. It has been a rule this thermographer has learned the hard way from personal experience. I can tell everyone that once a crewboat departs the dock or landing for offshore, it is not going to turn around and come retrieve a tardy Mr. Thermographer. This can cause several potential damaging problems. First, there may not be another ride available for some time so it's possible that the job and revenue accompanying it could be lost. Second, it is often several hours traveling one way just to get to the dock or landing that the crewboat is departing from. It can be costly to the Service Company to have a wasted day for the technician.

Not only can the travel to these offshore platforms be difficult to schedule, but it can also be physically taxing on the thermographer or technician himself. As stated above, the time of traveling to the dock or landing, combined with the time traveling in the crewboat often adds up to a whole day or more for the thermographer before his job has even begun. This can be physically and mentally wearing to someone who is not used to working those types of long hours. Many times the rig's personnel are ready to begin the job upon the technician's arrival since these platforms operate twenty-four hours a day and seven days a week.

The ride itself out to the rig in the crewboat can be physically draining. Many times rough seas make for a bouncing, miserable ride that anyone who has never experienced it could not imagine. Four to six foot seas or more can cause a ride for hours or more that is best described in my mind as similar to a non-stop roller coaster ride. This is why we in the industry say the second golden rule of offshore service personnel is never leave home without your motion sickness pills. For anyone who has never experienced becoming seasick, and staying that way for several hours, believe me it is not one of life's more pleasurable experiences.

The second common mode of traveling to and from jobs on offshore platforms is helicopters. Typically these are small and fairly fast and maneuverable choppers that are a quicker way than crewboats. The same scheduling problems and headaches described above also apply when traveling by helicopter. One must still work out the logistics of departure times and make sure to never be late because a helicopter is not going to return to pick you up either once it has departed. So, once again, the marine thermographer's first golden rule applies.

The travel on these helicopters at low altitudes and fairly high speeds can also be a literally sickening experience. Becoming airsick is just as unpleasant as the before mentioned seasick. At least if you become seasick while on a crewboat you can go over the side or into the restroom, or head, as it is known on vessels. If you get airsick in a helicopter, you better hope there are a bunch of those little airsick bags available.

Another point that often becomes a problem when traveling by helicopter is a weight issue. Just as is the case with all air transportation, excess weight can become a serious problem. All of these helicopters have weight limits as to the maximum they can carry. For people like myself who often perform more than a single maintenance service at a time, this develops into a complicated dilemma. It becomes difficult to decide which equipment to bring when you arrive for your flight, weigh in yourself and your equipment and are told you cannot bring everything with you. It also creates other dilemmas like where to store the equipment that you are not allowed to carry.

As mentioned before, the landing or air pad is often several hours traveling to get to. I personally do not get excited and comfortable about leaving a very expensive piece of test equipment of some type locked in a vehicle in a parking lot. These parking lots and airstrips are usually in isolated areas and typically have little or no security. These

types of strange dilemmas and problems that occur to the offshore thermographer are some of the most different aspects experienced when performing this type of thermography. As one can see, it can be quite a bit different than what most land-based thermographers deal with when trying to schedule and travel to a job.

An important lesson learned by this offshore thermographer and practiced by most marine maintenance technicians in general, is not to perform service work for offshore clients for a firm fixed price. Some of the details and travel logistics, as mentioned before, can make giving firm bids or fixed prices a very risky proposition. This, combined with the fact that sometimes weather or other factors, can cause a one or two-day job to turn into several days or weeks of unexpected delays and costs. We always try to perform offshore service work on a time and material basis with built-in travel and standby rates.

If a client wants a price before the job is performed, it is my typical policy to give an estimated cost making it clear that it is, in fact, an estimate. We also make it clear that standby rates will apply to all time incurred due to unforeseen delays. Once offshore, you are at the mercy of rig personnel and the weather as to when you can leave. This thermographer has personally been on an offshore platform for days and even weeks waiting for the next crewboat or helicopter to get me back to land. As one can imagine, this could be a costly arrangement if an agreed upon fixed price for two days of work turned into a fourteen day adventure. It can also become a big problem if another client is expecting you and has an important job scheduled, but you are unable to make it due to these types of unforeseen delays. When you start adding together the possible financial losses and problems of these delays, plus possible lost jobs or clients, it can become very damaging to the profit margin.

All of these types of problems can be made even worse because many times there is little or no method of communication to let anyone know what has happened. Cell phones typically do not work at most platforms, and although many have satellite communication of some type, it is very costly and usually for rig business only. Sometimes your boss can become irate with your MIA status and even think you have taken an unplanned or unscheduled vacation. This is especially true when your boss is a grumpy old man who also happens to be your father, as is the case for me.

At the same time, of all the negative problems this type of work can cause, there are some positive aspects that apply also. For one thing, the standby rates and extra travel time that may apply can be a financially rewarding gain. Many times, projected revenue from a job can double or even triple if you cover your standby and travel issues properly. Also, it is very rewarding personally to deal with all these types of problems and logistical concerns and complete a job in a timely and satisfactory manner. To know that you battled many pitfalls fighting against you and still come out on top is a very good feeling.

For the most part, the same basic safety issues and precautions that apply to all thermographers also apply to those performing thermography for offshore oil platforms. Basic common sense rules such as don't touch it to see if it is really hot, maintaining a safe distance from the target, and wearing proper protective equipment apply to these types of surveys as well. Just as is the general rule when performing thermography for industrial or commercial facilities, the minimum safety precautions and equipment must meet that as specified by the end user.

There are some interesting safety issues and concerns that are also very different from normal industrial and commercial facilities. One thing that is quite different, and not fully understood by many, is who governs safety regulations for these types of platforms. For the most part, safety regulations for industrial and commercial land-based facilities are governed by OSHA and other similar organizations. Once again, this is quite different when performing any type of marine service work. Typically, marine structure safety regulations are governed by two organizations. The first is the United States Coast Guard (USCG) and the second is the American Bureau of Shipping (ABS). These two organizations work both separately and in conjunction with each other to stipulate safety regulations for most marine facilities including offshore oil platforms. As also is the case in land-based facilities, most clients or end users will have further safety rules and regulations that must be followed for their specific facility.

Another different and interesting safety concern encountered by the marine thermographer is the limited space of operation typical to all marine facilities and vessels. As is typical to any type of marine facility or vessel, space is always at a premium because it is so limited. Engineers who design any type of marine structure or vessel do not design them with the thermographer in mind. One must always be aware of the close proximity to the target of everything aboard marine vessels or structures. Some of the most typical safety concerns because of these tight quarters are low overheads, tripping hazards, the close proximity of steam lines and traps, steep and narrow stairways and vessel motion.

All of these types of things can be very dangerous to the thermographer if he/she is not constantly aware of them. Another interesting point faced by the marine thermographer, because of this previously mentioned lack of space, is getting a good clear line of sight to the target. Many times a clear line of sight to a target can be blocked by other equipment. There are also times when things like cabinets and controllers are difficult to open. For this reason, many times the marine thermographer must use special equipment such as wide-angle lenses and front surface mirrors to complete the inspection. It is also why the marine thermographer must often use some special ingenuity and physical dexterity not often required by other thermographers.

Yet another different and interesting safety concern for performing thermography on offshore oil platforms is boarding the structure from the crewboat or helicopter. Many times, the way you board a structure from a platform is to climb a vertical steel ladder. Several things about this can be interesting and dangerous. The first goes back to the problem of rough seas previously mentioned. It can be very tricky and dangerous

climbing from a crewboat bouncing up and down in rough seas onto the platform's boarding ladder. One runs the risk of crushing or smashing feet and hands if the boat catches them between itself and the platform. The second is that many times the boarding ladders of the platforms become very slippery with slime. Once again, this can be very dangerous and great care must be used not to slip. You always want to wear your life jacket when leaving a crewboat and climbing on a platform. My motto has always been wear your lifejacket, be very careful, and if you slip, hope the sharks are not real hungry. As you can see, there are some interesting and dangerous safety issues and concerns that are not typical to most thermographers performing land-based surveys of industrial and commercial facilities.

The typical applications that thermography is applied to for offshore oil production platforms are often not that different from industrial and commercial land-based facilities. The most common application is electrical system surveys that all thermographers know and love. A typical electrical survey for a production platform would cover items such as switchboards, motor control centers, circuit breaker panels, transformers, and junction boxes for large motors and generators. As one can see, this is indeed very similar to most all-electrical system surveys.

One major difference however, is the amount of time and effort put into surveying the structure's generating system. Many times commercial buildings, hospitals and other land-based facilities have a generator for emergency purposes. It has been my personal experience when performing these types of surveys that the generator is not even put on line or under a load to inspect. We all know this happens all the time. Aboard these platforms, the generating system is the true lifeline of the structure and is treated as such when performing thermographic surveys. These platforms do not have the option of buying electricity from the local power company since they are hundreds of miles out in the ocean. It is very normal for the generating system, all controls associated with it, and all backup generating systems to receive the most attention from the thermographer.

There are also typical mechanical surveys performed aboard these platforms that are very similar to those performed for normal land-based facilities. Equipment is often surveyed for bearing problems, shaft alignment, steam traps, pressure relief valves and belt and pulley exceptions. There is really no difference at all when performing these types of mechanical inspections on production platforms as compared to land-based facilities. There are other types of mechanical thermography surveys performed that are different and unique to these types of platforms. Some of these will be discussed now.

One important mechanical application vital to the safe operation of these platforms is using thermography to inspect the drill that goes down into the ocean floor where it couples to the gearbox driving it. Another is using thermography on gearboxes that are vital to the production and operation of the platform. Infrared has helped to quickly and

accurately determine problems with gearboxes such as low oil levels and bearing or gear problems. Many times infrared will alert us to a potential problem so that other technologies like vibration analysis and oil analysis can confirm the problem.

Another very important aspect of this type of work is the even greater than normal necessity of accurate recording and reporting of equipment surveyed and deficiencies found. Offshore platforms almost always have two identical pieces of equipment onboard that must be surveyed. This is for backup capabilities due to the extreme difficulty in procuring and storing spare parts and equipment. Some examples of this are forward and aft lube oil pumps, and inboard and outboard fresh water cooling pumps. For many people who have never been in the machinery spaces of a production platform, it is very easy to become disoriented as to what is forward or aft, etc. This, along with the fact that no two rigs label or name equipment alike, can be very confusing and lead to misnaming equipment.

Great care must be taken when reporting a deficiency to the person in charge, usually the rig foreman or superintendent. Most times the deficiencies found are repaired by the rig crew after the surveyor has completed their job and left the ship. Because of the location and communication problems previously discussed, phone calls, e-mails or faxes to clarify the deficiency become difficult or impossible. It is not the same as Mr. Smith at Goodberger Realty calling the local thermographer to clarify a question. The accuracy of reporting the correct equipment found with a deficiency and the communication of this same equipment to onboard personnel in charge is of utmost importance. This, combined with the fact that follow-up surveys are seldom performed until the next survey due date, typically a year later, makes this element of precise reporting very important.

Conclusion

It is true that many of the practices and applications of performing thermography for stationary marine structures are similar to those for performing land-based thermography. There are, however, different logistical concerns, potential problems, different applications and safety issues that most people performing only contemporary land-based thermography would never realize. Thermography for these types of stationary marine structures is as important and vital as it is to our land-based clients. I hope I have been able to give all of those reading this paper some insight to some of the differences and adventures a marine thermographer faces on a daily basis.