

# The ARCADIA

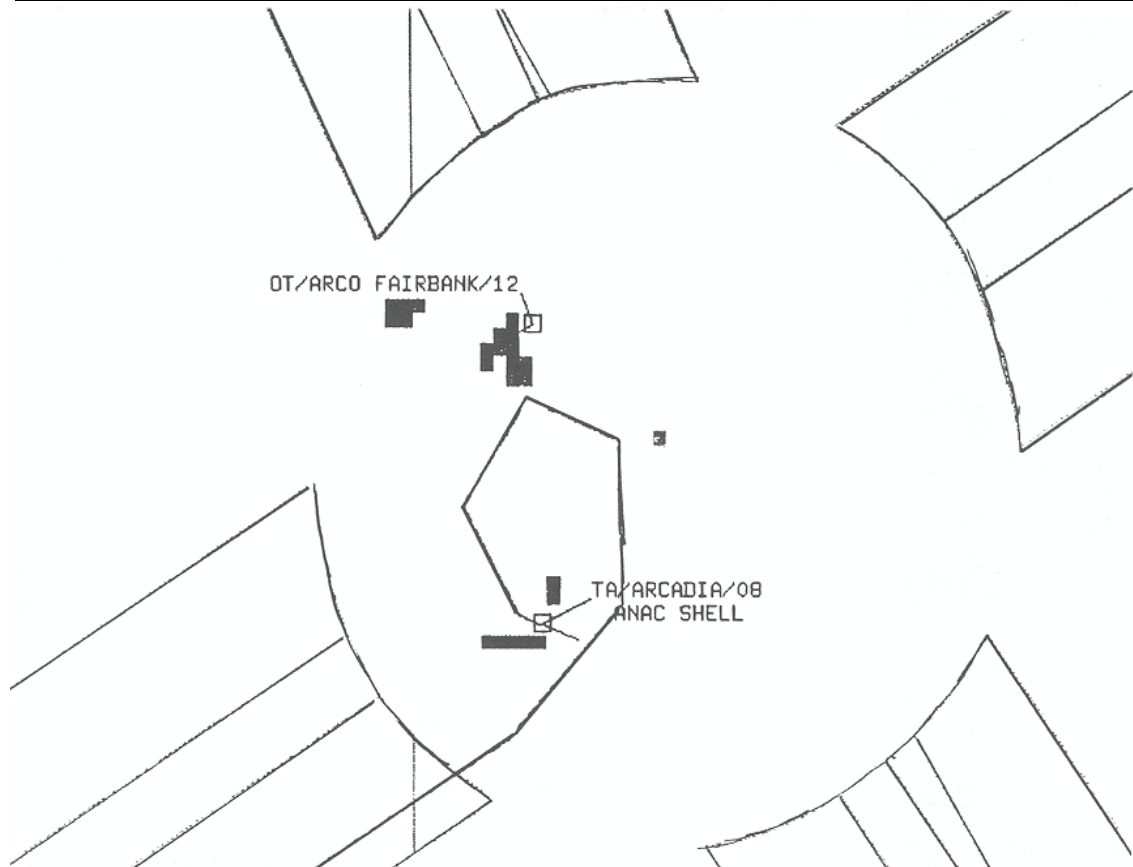
## PREVENTION BULLETIN 98-01

### OVERVIEW

On October 22, 1996, the Greek-flag oil tanker ARCADIA was being piloted inbound through the Strait of Juan de Fuca for a refinery at Anacortes, Washington with a cargo of approximately 250,000 barrels of fuel oil. As the ARCADIA, under escort by two tugs, approached the precautionary area near buoy "RA" enroute to Rosario Strait, the ship lost steering control. The ARCADIA turned to port and crossed the intended path of the outbound American-flag tanker ARCO FAIRBANKS, also partially laden and under tug escort.

The pilots of the two vessels were in communication with each other by radio. The ARCADIA's pilot continued the turn to port once steering control was restored, eventually completing a 360 degree turn to bring the ARCADIA back to its intended course. The escort tug ARTHUR FOSS eventually tied off to the ARCADIA as a precaution. The ARCO FAIRBANKS slowed to allow the ARCADIA to complete its turn with adequate sea room.

The U.S. Coast Guard (USCG) refused the ARCADIA permission to proceed through Rosario Strait to its destination. The ARCADIA turned back and anchored at Port Angeles.



— VTS printout showing ARCADIA's turn. Unlabeled dot at center is Buoy "RA". —

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## PROBABLE CAUSE

The loss of steering aboard the ARCADIA occurred due to a loose electrical connection on the steering gear's number one hydraulic control solenoid. The loss of steering was apparently facilitated by the connection being overlooked during a regular maintenance check.

- Contributing to the cause of this incident were:
- Failure to detect the loose electrical connection during normal maintenance checks.
- Failure of the company's maintenance procedures to ensure adequate completion of regular maintenance checks.

## SAFETY ISSUES

Safety issues discussed in this report are:

- The importance of ensuring that a planned maintenance system is in place and is properly executed and results recorded;
- Observed causes of steering gear failures; and
- Factors that prevented a near-miss incident from becoming an accident.

## VESSEL INFORMATION

### *General Characteristics of the T/V ARCADIA*

The 62,654 deadweight ARCADIA is operated by Universe Maritime Ltd. The ship is 218 meters (717 feet) in length with a beam of 32 meters (106 feet). When fully laden, the ship has a cargo capacity (98%) of 66,974 cubic meters (approximately 435,000 barrels). ARCADIA's draft was 28 feet forward and 31.4 feet aft at the time of the incident.

### *General Characteristics of the T/V ARCO FAIRBANKS*

The 122,520 deadweight ARCO FAIRBANKS is operated by ARCO Marine, Inc. The ship is 269 meters (882 feet) in length with a beam of 42 meters (138 feet). When fully laden, the ship has a cargo capacity (98%) of 134,684 cubic meters (approximately 875,000 barrels).

## ENVIRONMENT

### *Locale*

The ARCADIA lost steering control in a precautionary area at the intersection between two traffic separation schemes crossing at nearly right angles. The precautionary area is centered on Buoy "RA" which lies about 5 nautical miles (Nm) west of Smith Island, Washington. Charted depths in the area are approximately 60 to 90 fathoms. Six miles to the north lies the San Juan Archipelago of Washington.

The separation scheme followed by the ARCADIA and ARCO FAIRBANKS tends northeast/southwest, and is the main tanker route for vessels heading for refineries at Anacortes, Ferndale and Cherry Point, Washington via Rosario Strait from the Puget Sound Pilot Station at Port Angeles, Washington. Laden tankers of 5,000 gross tons or more transiting this area

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are required to have one or more tug escorts. The area is monitored by the USCG Puget Sound Vessel Traffic Service.

## *Weather and Tides*

Wind at the time was southerly at between 10 and 20 knots. Visibility was better than five miles. There was a slight swell out of the south of one to two feet. Predicted currents for the vicinity (based on a station 2.8 miles SSW of Cattle Point, San Juan Island, Washington) were less than 0.5 knots, flooding towards the northeast. Slack was predicted for 0230.

## **THE TRANSIT**

The ARCADIA reached Buoy "J" at the entrance of the Strait of Juan de Fuca on the evening of October 21<sup>st</sup> at about 1820. The ship was bound for the Texaco/Shell Terminal at March Point, near Anacortes, Washington. Estimated time of arrival at the terminal was 0800 on October 22<sup>nd</sup>, where the ARCADIA was due to load approximately 85,000 additional barrels of fuel oil.

At 2335 on October 21<sup>st</sup>, the ARCADIA boarded a Puget Sound Pilot at Port Angeles, Washington, and went full ahead on its engine (approximately 11 knots). According to the VTS vessel track analysis printout, the ARCADIA began to swing to port shortly after 0104. At that time the ARCADIA was just entering the precautionary area from the southwest. At approximately 0105 the ARCO FAIRBANKS received a radio call from the ARCADIA on VHF channel 5A. The ARCADIA indicated that the rudder was not answering the helm and was to port. At the time the ARCO FAIRBANKS was on a course of 238 degrees at 13 knots, and was about 4 miles from the ARCADIA. At 0106 the ARCO FAIRBANKS reduced engine speed to slow ahead.

At between 0112 and 0113 the VTS sector operator noted the ARCADIA's swing to port, attempted to call the ship and received no reply. The VTS operator then called the ARCO FAIRBANKS which confirmed the ARCADIA's swing to port. This concerned the VTS operator, who then raised the ARCADIA's escort tug, ARTHUR FOSS, via VHF radio at approximately 0114. The ARTHUR FOSS indicated to the VTS operator that they were tethered to the ARCADIA and that the steering on the ARCADIA had been restored. At 0116 the Pilot of the ARCADIA contacted VTS to confirm that the ARCADIA was under control, but did not have information regarding the cause of the steering control loss.

The ARCADIA swung approximately 50 degrees to port before steering control was restored. The Pilot aboard the ARCADIA chose to continue to circle to the left to come back to the intended course. During the turn the ARCADIA's engines remained at full ahead. The ARCADIA's speed (over ground) decreased to about eight knots from about 12.5 knots during the turn. This maneuver took approximately 19 minutes and brought the ARCADIA into the line of the outbound traffic lane-the intended path of the ARCO FAIRBANKS. The VTS printout indicates that the ARCO FAIRBANKS tracked to the right side of the outbound lane. It appears from the VTS printout that the two vessels had a closest point of approach of approximately one mile. Normally, two vessels centered in the inbound and outbound lanes will pass at a distance of approximately 0.8 Nm when following the separation scheme in this area.

Following the event, the two vessels continued towards their intended destinations. At 0200 the ARCADIA was informed by VTS Puget Sound that they were not authorized to transit

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Rosario Strait. The ARCADIA continued towards Rosario Strait at a reduced speed. At 0215 the GARTH FOSS, which had been escorting the ARCO FAIRBANKS, relieved the second ARCADIA escort tug, RICHARD FOSS. At 0230 the USCG Captain of the Port, via cellular phone, ordered the ARCADIA to proceed to Port Angeles anchorage to await inspection by the USCG. At 0250, via VHF channel 5A, VTS Puget Sound directed the ARCADIA to Port Angeles. At 0300 the ARCADIA, by then near the entrance to Rosario Strait, turned back for Port Angeles. The ARCADIA anchored at Port Angeles at approximately 0525.

## ANALYSIS

### THE STEERING CASUALTY

#### *Origin of Failure*

The steering gear failed when the control wire from the pilot house to the number one hydraulic control solenoid vibrated loose. According to the owner, the loose connection was in the steering gear space.

According to the Master's Statement of Facts the failure occurred "while the rudder was 10 degrees port." The Master indicated that steering was restored when the steering control was switched to the non-follow-up model<sup>1</sup>, but on further investigation it was found that the steering was restored by changing from the number one to number two steering pump system.

Following the determination of the source of the problem, the hydraulic solenoid's connection was re-secured. The USCG verified the operation of the steering gear following the repairs at Port Angeles. As a prevention measure, the owner indicates that the other steering gear electrical connections were checked and "locked tight with safety locks." The owner also indicated that they sent a circular letter to vessels under their management regarding the incident and "requesting them to clean all electrical connections, re-tighten, safety lock them and report completion."

#### *Pre-Arrival Steering Gear Test*

The ARCADIA completed a series of tests and inspections required by the Washington Office of Marine Safety<sup>2</sup> (OMS) under the terms of its waiver prior to arrival, including a test and inspection of the steering gear. All systems tested were apparently normal when the tests and inspections were conducted on or before October 19, 1996. ARCADIA completed the tests and inspections required under Code of Federal Regulations (CFR) 33 part 164.25 within twelve hours prior to entry into U.S. waters.

The use of both steering gear pumps by vessels of 1,600 or more gross tons in U.S. waters, where simultaneous operation is possible, is a requirement of 33 CFR 164.11(t). According to information provided by the ARCADIA's owner, only one of the ARCADIA's steering pumps can be operated at a time.

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<sup>1</sup> In the follow-up mode the steering gear "follows" the helm indicator thus turning the rudder until the rudder angle indicator and the helm indicator are at the same angle. In the non-follow-up mode the steering gear will continue to move in the direction ordered by the bridge until the actuating switch on the bridge is returned to the neutral position. The non-follow-up mode removes the automatic feedback loop in the steering gear system and provides the helmsman more direct control for changing the rudder angle.

<sup>2</sup> OMS is now part of the Washington State Department of Ecology's Spill Prevention, Preparedness, and Response Program.

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## *Maintenance*

According to the USCG inspectors' report "A walk through of the engineroom indicated that the vessel was being well maintained. Inspection of all documents indicated that a TVE [Tank Vessel Examination] was performed 08AUG1996, all other class documents were up to date, including required C.G. Docs. Inspection complete. No discrepancies noted."

At OMS' request, the owner provided documents regarding the maintenance of the steering gear system of the ARCADIA. The documents show that the September 1996 maintenance included "Megger test readings of machinery and network taken and reported. All electrical parts inspected." The October 1996 log indicates that "Power and emergency piping system inspected for good tightening and securing and found or placed in good order."

When the owner was asked whether "All electrical parts inspected," in the September 1996 log entry, included a check of the electrical connections, the owner replied that "The normal inspection of electrical components of the steering system include checking the connections also, but this solenoid connection may be was overlooked." The owner also indicated that the Chief Engineer normally conducts the inspections and maintenance on the steering gear, and that he had conducted September's inspection and maintenance.

In response to OMS' inquiry as to whether the ARCADIA, or any of the owner's other vessels, had experienced problems with loose electrical connections on their steering gear systems, the owner replied that they had not.

## *Drills*

The bridge team aboard the ARCADIA apparently had a procedure for dealing with a loss of steering control. The voyage plan submitted by the ARCADIA to OMS, and signed by the Master, indicates that the bridge officers reviewed their standard emergency procedures within a few days of the incident. Steering failure procedures were among those emergency procedures reviewed.

## *Prevention Action*

While the ARCADIA apparently had a planned maintenance program that includes the steering gear, and while the ARCADIA's owner has issued a circular letter to other vessels asking them to check their steering gear electrical connections, the ARCADIA's owners should also incorporate a specific check of the system's electrical connections in their regular maintenance program. Given the vibration that is experienced in steering gear spaces, such a specific procedure would be prudent. Furthermore, if the connection in question was simply "overlooked" then the owner should consider the development of a checklist that ensures such lapses are prevented.

## **LOSS OF STEERING INCIDENTS**

OMS' MIS (Marine Information System) records were reviewed for loss of steering incidents, and equipment failures and safety reports involving steering problems.

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The data derived from MIS indicate that electrical components of steering gear systems account for just over half (20 of 34) of the steering gear problems of known origin. Of those electrical problems about one-third (6 of 20) involve loose or broken electrical connections. These figures emphasize that ship operators would be well-advised to ensure that their steering gear maintenance programs include thorough checks of the electrical components of the system, and, in particular, electrical connections. Megger testing, thermographic testing, eddy current testing, or other non-destructive testing techniques as well as manual inspections of individual electrical connections should all be considered in designing a comprehensive steering gear inspection and maintenance program.

## **THE NEAR-MISS**

Reviewing a near-miss incident<sup>3</sup> can prove instructive as to "what went right." There are a number of factors that prevent an incident from becoming an accident with serious consequences.

The communication between the Pilot of the ARCADIA and the Pilot of the ARCO FAIRBANKS was apparently prompt and a passing arrangement to deal with the ARCADIA's loss of steering was reached early. The Pilot of the ARCADIA was also apparently in contact with the escort tug, ARTHUR FOSS, quickly. Finally, the VTS operator was alert to the movement of the two tankers and took action to contact both the ARCADIA and the ARCO FAIRBANKS to ensure their safe passage.

Also working in favor of the Pilots in this case was the environment. There was good weather. Good visibility allowed visual contact between the vessels, so the ARCO FAIRBANKS was able to see the ARCADIA turning to port. The location of the loss of propulsion afforded the room for both vessels to maneuver without significant danger of grounding.

The skill of the Pilots in choosing a course of action that maintained a comfortable separation between the vessels must be credited with preventing the incident from becoming more serious.

Timing played an important role in this case. The ARCADIA's turn to port occurred while the ARCO FAIRBANKS was still some four miles distant. Even with tug escorts, a steering failure when the two partially laden tankers were in closer proximity would have proven more dangerous. Furthermore, while the steering gear failure in this case presented a collision risk with another tanker, a loss of steering by the ARCADIA further along its intended route and about one hour later-entering the restricted waters of Rosario Strait-would have presented a risk of grounding.

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<sup>3</sup> According to Washington Administrative Code (WAC) 317-21-130(3)(c), "Near-miss incident which means a pilot, master, or other person in charge of navigating a tank vessel successfully takes action of a non-routine nature to avoid a collision with another ship, structure, or aid to navigation, or grounding of the vessel, or damage to the environment."

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## CONCLUSIONS

- The ARCADIA lost steering control as the result of a loose electrical connection to a hydraulic control solenoid.
- The loose electrical connection went undetected despite an apparently regular maintenance regime.
- A steering gear failure due to electrical problems and, specifically to a loose electrical connection, is not an occurrence unique to this case.
- Steering was restored to the ARCADIA by shifting from steering system number one to steering system number two.
- The near-miss that occurred following the ARCADIA's loss of steering did not become an accident as the result of good communication, good visibility, appropriate pilot response, a prepared bridge team, and fortuitous timing.

## LESSONS LEARNED

- Steering gear is a critical vessel safety system. As such, steering gear systems must be properly maintained. However tedious, inspections of the electrical connections of the system must be part of the maintenance program. The maintenance program should be structured to minimize the opportunity for human errors.
- In an emergency situation, good communication, a prepared bridge team, and the skills of a trained pilot can be the difference between a near-miss and an accident.

## RECOMMENDATIONS

### To Ship owners and operators:

- Ensure that steering gear is properly maintained under a comprehensive planned maintenance program that minimizes the likelihood of human error and conforms with the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code), especially Section 10. All electrical connections should be regularly checked for integrity as part of such a steering gear maintenance program.
- Ensure that personnel are familiar with, and drilled in using emergency steering procedures.
- As soon as possible, implement Bridge Team Management training programs, consistent with the new STCW Convention (International Convention on Standards of Training, Certification and Watchkeeping For Seafarers) requirements, to insure good internal and external communication.

*Follow-up correspondence with the owner of the ARCADIA indicates that the company has implemented or is implementing the recommendations made in this Bulletin.*

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