



U.S. Department of Transportation

National Highway Traffic Safety Administration

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If you requested NHTSA to query its database files in order to identify a specific crash, then that query was made using non-personal descriptors you provided for use in our search. This motor vehicle crash may have been identified from a data search and matches the general, non-personal descriptors you provided, but we cannot confirm that this is the specific crash report you requested.

If you have any questions with regard to the above procedures, please contact the Field Operations Branch, Crash Investigation Division, National Center for Statistics and Analysis at 202-366-4820. Again, please be advised that we cannot confirm that this is the case that you have specifically requested nor can we certify the information to be correct.

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TRANSPORTATION RESEARCH CENTER

Indiana University Bloomington, Indiana 47403-1599

REMOTE ALLEGED SAFETY-RELATED DEFECT REPORT

CASE NO. - 94-19
FLEET - PUBLIC TRANSIT VEHICLE
LOCATION
INCIDENT DATE
1994

Submitted By:

Senior Staff Associate

1995

Contract Number:

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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This report covers a remote, alleged, safety-related defect investigation that involved the leakage of compressed natural gas (CNG) from a CNG relief valve on a cylinder of a 1993 model transit bus. The leakage occurred during refueling. Based on copies of correspondence between the valve manufacturer and the public transit firm, which this contractor obtained, this contractor learned that the CNG leakage problem involved two components. First, a manufacturing process failure allowed a 4500 p.s.i. "poppet" (i.e., a pressure relief valve) to be installed on the CNG cylinder instead of a 5400 p.s.i. poppet, and second, the fittings to the body(ies) on the pressure relief valves were over-torqued at some point, either during the installation or the production process. The resulting leakage prompted either the replacement of all poppets, or at a minimum, their testing to insure the correct poppet was in place. According to the information provided to this contractor, this defect resulted in over twenty-seven seperate incidents throughout North America, none of which reportedly caused any injuries.					
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Alleged Safety-Related Defect	•				
Gas Cylinder Leakage					
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Unclassified	Unclassified		14	\$5,000	

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TRC/IU REMOTE ALLEGED SAFETY-RELATED DEFECT REPORT

TRC/IU CASE NO. 94-19

FLEET - PUBLIC TRANSIT VEHICLE LOCATION

SUMMARY

This report concerns a motor vehicle incident involving a compressed natural gas (CNG) powered 1993.

to model transit bus, ocurring on 1994, at in at a transit bus fleet fuel service island located near a city street. This incident is of special interest because: (1) the transit bus was powered by an alternative fuel (i.e., CNG), (2) the potential safety hazard associated with the leakage of compressed natural gas, and (3) the increased useage of alternative fuels in the public and private sector.

During the refueling of the transit bus, a safety-related defect occurred that involved the leakage of compressed natural gas (CNG) from a CNG relief valve on a cylinder of the transit bus.

Based on copies of correspondence between the manufacturer and the public transit firm, which this contractor obtained, this contractor learned that the CNG leakage problem involved two components. First, a manufacturing process failure allowed a 4500 p.s.i. "poppet" (i.e., a pressure relief valve) to be installed on the CNG cylinder instead of a 5400 p.s.i. poppet, and second, the fittings to the body(ies) on the pressure relief valves were over-torqued at some point, either during the installation or the production process.

The resulting leakage prompted either the replacement of all poppets, or at a minimum, their testing to insure the correct poppet was in place. According to the information provided to this contractor, this defect resulted in over twenty-seven seperate incidents throughout North America, none of which reportedly caused any injuries.

TABLE OF CONTENTS

	<u>Page No.</u>
• • • • • • • • • • • • • • • • • • • •	
CE	
ort of the City of ardous Materials Engin	eer 5
ort filed with the he Railroad Com	Division mission 7
ters from the Transit A	ithority to the
nsit Authority and a Le	the tter from the Valve Manufacturer 12
	ort of the City of ardous Materials Engin ort filed with the he Railroad Com

TRC/IU REMOTE ALLEGED SAFETY-RELATED DEFECT REPORT

TRC/IU CASE NO. 94-19

BEST AVAILABLE

FLEET - PUBLIC TRANSIT VEHICLE LOCATION -

INCIDENT DATA

Location/Street: Compressed

next to a City Street

City/Township:

Area/Type: Urban, commercial

Incident Date/Time: 1994 @ 3:6 v.m.

Investigating Police Agency: here Department

Incident Type: Transit Bus - fuel leakage

Occupant Injury Severity

(air bag vehicle): No Injury (AIS-0)

VEHICLES¹

Case Vehicle¹

Year: 1993

Make:

Model: RTS08

Body Type: Transit bus

V.I.N.: 1TUMDTEA0PR-----¹

Mileage: Unknown

Windshield damage/source: Not applicable

Active Restraints: Unknown

Passive Restraints: None

Fleet: Public transit vehicle

Tow status: Not towed as a result of this incident

¹ This Vehicle Identification Number passed the check digit test.

VEHICLES (CONTINUED)

Case Vehicle

Reported Defects:

Compressed natural gas leakage from the pressure relief valve of a CNG cylinder

INCIDENT SEQUENCE

This contractor was assigned to investigate an incident involving a pressure relief valve failure which occurred during the refueling of a public transit bus. Based on the information from the City of and the at (i.e., the bus company), it was learned that there had been two other incidents of this type that had occurred within a three-month period at this compressed natural gas (CNG) bus refueling facility.

This contractor was able to obtain copies of the following documents: (1) the re-(see Appendix A), (2) a report filed with the port filed by the of the Appendix B), (3) two complaint letters written from the Transit Authority to manufacturer of the transit buses (Appendix C), and (4) a letter written from the to the Transit Authority which referenced and enclosed a letter from the manufacturer of the pressure relief valves to the manufacturer of the transit buses detailing the findings of the valve manufacturer pertaining to the defective valves (Appendix D). Both reports (Appendices A and B) are required to be filed by state law. Both reports essentially state that: (1) a pressure relief valve failed at a pressure² below the rated pressure of the cylinder's valve and (2) the failure occurred during the refueling process of a sixty pound³ compressed natural gas cylinder (one of twelve) mounted on a bus. According to the report to the amount of compressed natural gas released was 9,035 the standard cubic feet or apporximately 65 gallons. The gas release set off several alarms on the premise at the refueling station which not only alerted the fire department but also shut down the whole refueling system preventing an explosion from occurring.

According to a letter⁴ sent from the manufacturer of the pressure relief valves to the manufacturer of the transit buses (see **Appendix D**), this contractor learned that the valve manufacturer indicated that all three⁵ of the CNG leakage incidences, experienced by the Transit Authority, were in part their mistake. This contractor contacted the Institute for and learned that twenty-seven other such CNG leakage incidents, involving these manufactured pressure relief valves, reportedly occurred throughout North America, none of which reportedly caused any injuries. One month after the three

Pressure is measured in pounds per square inch (i.e., p.s.i.).

³ Sixty pounds is the weight of the cylinder when completely filled with compressed natural gas.

This statement is based on the information contained in the correspondence obtained by this contractor.

See APPENDIX C, letter dated 1994.

INCIDENT SEQUENCE (CONTINUED)

valve failures occurred at the Transit Authority's bus refueling station, the valve manufacturer⁴ was able to identify two possible causes for the failures (see Appendix C, letter dated 1994):

- (1) a manufacturing process failure allowed a 4500 p.s.i. "poppet" (i.e., a pressure relief valve) to be installed on the CNG cylinder instead of a 5400 p.s.i. poppet, and
- (2) the fittings to the body(ies) on the pressure relief valves were over-torqued at some point, either during the installation or the production process.

The Transit Authority indicated in a letter sent to the manufacturer of the (see Appendix C, letter dated 1994) that both of the potential reasons for failure cited above by the valve manufacturer were of sufficient likely cause that the manufacturer of the transit buses should agree to have all the pressure relief valves replaced or, at a minimum, tested to ensure that the correct poppet had been installed and the fittings properly torqued.

After the valve manufacturer inspected the defective internal components (i.e., poppets) from the thermal units (i.e., cylinders) exchanged with the Transit Authority, the valve manufacturer determined (see Appendix D) that besides the units being in poor condition, nine out of ten showed evidence of over-tightening (i.e., excessive torque). Of greater concern to the valve manufacturer was the finding that six of the nine showed evidence of severe excessive torque with some accompanying trigger ball movement. According to the valve manufacturer, any appreciable amount of trigger ball movement results in a weakened trigger which may be susceptible to premature failure under high stress conditions such as simultaneous high pressure and temperature loading. The valve manufacturer pointed out that two of the three pressure relief valve failures were attributed to premature trigger failure, which resulted from over-tightening; the third failure was due to the installation of a lower rated poppet in a higher-rated cylinder.

The valve manufacturer (see Appendix D) also indicated to the manufacturer of the transit buses that they learned that their installer's practice of "tweeking" or "re-adjusting" the pressure relief valves, in order to realign the thermal trigger to a preferred orientation, may have occurred more often than they believed; this practice may have caused a weld failure.

Finally, the valve manufacturer determined⁴ that all the pressure relief valves that this manufacturer supplies, throughout need to be replaced and, due to the fact that their spare parts supply was low, they decided that a retrofit campaign was "the way to go". Essentially⁴, the valve manufacturer has set up a schedule with the transit bus manufacturer that will have the Transit Authority take so many buses out of service, replace the defective units, and then return the buses back to service. Eventually,

The correspondence implies that the testing and/or replacement of the valves on the transit bus manufacturer's buses was to be undertaken by the valve manufacturer.

INCIDENT SEQUENCE (CONTINUED)

all the defective units will be replaced. Until all transit buses are fixed, the
at the Transit Authority intends⁷ to only fill the CNG cylinders
two-thirds full, hopefully preventing any further failures. As of this report⁷, there have
been no other failures, and the retrofitting is scheduled to be completed within the next
three to five months.

⁷ This statement is based on our telephone conversation with this individual.

Appendix A:

REPORT OF THE

FIRE DEPARTMENT HAZARDOUS MATERIALS ENGINEER

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Appendix B:

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(LP) DIVISION

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Here report is made to comply with the provisions of 16 TAD sections 8.87 and 13.36 and is NOT a determination of responsibility or fault.				

BEST AVAILABLE

Appendix C:

LETTERS FROM THE TRANSIT AUTHORITY
TO THE

1994

Warranty and Sales Engineering

Dear

Re: Failure of Pressure Relief Valve Valve)

has had a 3rd Pressure Relief Valve failure in the fleet. An immediate response to resolving this problem needs to be initiated before a serious incident involving a fire or injury occurs. On 1994 the first valve failed on Coach

I contacted to relay this problem on the first failure. His response was less than favorable, so did what we felt prudent at the time.

A second valve failed on Coach on This valve failed in the same manner as the one on Coach I spoke with about these failures when he arrived on the On the I prepared a memo to to address this problem. had left before I had a chance to give him the letter

A third failure has occurred. On a valve failed and the vent manifold line came apart on Coach Since this incident occurred during fueling has reported this problem to the as is required by law. The problem is with

the pressure relief valve P/N and the vent manifold connectors failing to hold together when the pressure relief valves fail.

feels there is a need to address this problem at the highest priority and request an immediate response to getting this problem corrected by

Sincerely,

Quality Assurance Specialist

xc:

Re: Failures of Pressure Relief Valves

Dear Mr.

The recent failures of the pressure relief valves has created a very safety sensitive issue for our organization and the community we serve. Regulatory agencies at the State and City level are questioning the safety of the Consequently, we feel some action must be taken quickly to resolve the problem with the pressure relief valve.

Personnel from Controls have explained to us that they identified 2 possible causes for the valve failures:

- A manufacturing process failure which allowed a 4500 psi "poppet" to be installed versus the 5400 psi poppet.
- 2) Fittings to body(s) on valves were over torqued at some point during the installation/production process.

We believe both potential reasons for failure are sufficient cause to have all valves replaced or at a minimum be tested to ensure the correct poppet parts are installed and the fittings have been correctly torqued.

In view of the fact these coaches are under warranty, we feel it is the responsibility of to develop a course of action, provide replacement valves and supply an adequate labor force to correct this potentially hazardous situation. A report was due to the which explained the problem; however, it was submitted incomplete due to the problem not being resolved satisfactorily. Consequently, your immediate attention to this matter in a timely manner is important.

We look forward to your reply and working together to solve this issue.

Sincerely,

Director of Vehicle Maintenance

XC:

Appendix D:

LETTER FROM THE

TO THE

AND A

LETTER FROM THE

TO THE

Fax.

LIQUEFIED PETROLEUM GAS DIVISION "YOUR SAFETY IS OUR BUSINESS"

1994

MANAGER VEHICLE MAINTENANCE

Subject:

Cylinder Relief Valve Failure

Subsequent to our initial conversation, in regard to the subject, I have contacted the relief valve manufacturer and I have discussed the matter with Mr.

Engineering Manager and has since. fixed me a copy

of, his letter to indicating the cause of the subject failure and their course of action in the matter.

If you have any quastions herewith, please advise.

Sincerely,

PLANS APPROVAL/ACCIDENT SECTION

cc: File

In view of this situation, and given the need to replace the units at our earliest opportunity, we have elected to "break into" our production schedule this week to manufacture approximately 150-175 additional "TMC Style" thermal units. These units will have priority scheduling through our shop, with initial production sub-lots available in about ten (10) days,

The availability of the expanded pool of replacement valves should make it easier to schedule a series of retrofit campaigns at Because of the number of units involved (346 remaining), we will still need to rebuild a number of the returned lock-tighted units on a priority basis in order to keep up with the flow. Thus, we would appreciate your continued cooperation in returning the removed units directly to us as quickly as possible.

Also, per our conversation, I have instructed our Sales Department to make these replacement units available to you or your customers on a no-charge memo billing basis. This is irrespective of the fact that we have still hot been paid for all of the original order by your supplier, and our opinion that our shop practices and quality assurance procedures were not responsible for the vast majority of the problems you and your customers are experiencing. As I indicated, Companies have a long established policy of coming to the assistance of sustomers who, for one reason or another, are having problems - irrespective of all the details as to how the problems occurred or who may have been at fault. Of course, hindsight being 20/20, one could argue that we should have opted for the higher "IP" option initially, but given the trouble we're having disassembling the lock-tighted units, our initial decision is more understandable.

On the broader subject of "bullet-proofing", I believe I mentioned that we are in receipt of two (2) welded thermal units returned (for warranty) from another customer. Concurrently, it has come to our attention that the installer practice of "tweeking" or readjusting, to realign the thermal trigger to a preferred orientation may have been more common than earlier believed. Obviously, welded units are not easily tweeked, but a determined effort to do so may lead to weld failure.

In light of this development, we have elected to rachet the IP factor one more notch. To this end, we have special ordered stainless drive pins. We intend to begin installing the pins as soon as they're available. Thermais that have been configured (drilled) for welding will also be drive-pinned on the opposite hax face. Units not prepared for welding will be double drive-pinned on opposing hex flats. We believe this anchoring process will raise the IP factor to a ten (10) which is roughly equivalent to

1994

Page -3-

"steel jacket bullet proofing".

I have instructed my people to stay in close contact with you as our expanded inventory pool becomes available. And, again, we regret all the inconvenience this problem is causing you and your customers.

Please feel free to contact me if you have any further thoughts or suggestions.

Sincerely,

- Phone:

1994

1954

Confirming our phone conversation last week, we have completed our inspection of the internal components from the thermal units returned (exchanged) from and and it is apparent that the units are generally in much poorer condition than the units. Nine (9) out of ten (10) from show evidence of "over-torqueing". Of greater concern is the finding that six (6) of nine (9) showed severe "over-torqueing" with some accompanying trigger ball movement. This is potentially serious because any appreciable amount of trigger ball movement results in a "weakened" trigger which we theorize, may be susceptible to premature failure under high stress conditions such as simultaneous high pressure and temperature loading.

In contrast, the units are generally in excellent condition, although there were several with double sets of internal ball marks, which indicate some re-torqueing has occurred.

Of course, it is always risky to draw conclusions from relatively small sample sizes, but the fact that two (2) of the three (3)

Isitures were attributed to premature trigger failure resulting from over-torqueing (the third was traced to factory installation of a lower pressure rated;

poppet), coupled with the information that the waive/tank systems were assembled via a different route from systems, would lead us to conclude that there is a strong possibility that the conditions we observed on the single bus set would be pervasive throughout the

Given this background, it would normally be our recommendation that priority be given to exchanging the older design lock-tighted units at with our new welded model (with the higher "IP" factor). However, given the fact that the exchange is already proceeding, and is essentially tying up all of our over-run inventory, this does not seem to be an available option. To complicate the situation further, we are experiencing a fair amount of difficulty disassembling the lock-tighted returned units and, as a result, the "casualty rate" is slowly eating up our meager supply of spare parts.