

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NASA CONTRACT NO. NASW-4598
TASK ORDER NO. 49

ENVIRONMENTAL ASSESSMENT FOR
THE TRANSONIC DYNAMICS TUNNEL (TDT)
HEAVY GAS REPLACEMENT (BUILDING 648)
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA

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April 1995

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LIST OF ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACOE	Army Corps of Engineers
AEL	Acceptable Exposure Level
atm	atmosphere
Btu	British thermal unit
CEQ	Council on Environmental Quality
cf	cubic foot or cubic feet
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CRMP	Coastal Resources Management Program
DEQ	Department of Environmental Quality
EA	Environmental Assessment
EPA	Environmental Protection Agency
ft	feet, foot
ft ³	cubic foot or cubic feet
FONSI	Finding of No Significant Impact
fps	feet per second
FY	Fiscal Year
GN ₂	Gaseous Nitrogen
hp	horsepower
HRPDC	Hampton Roads Planning District Commission
in	inch
kg	kilogram(s)
km	kilometer(s)
kPa	kilopascal(s)
LaRC	Langley Research Center
lb	pound(s)
LHB	Langley Handbook
m	meter
m ³	cubic meters
mg/kg	milligram per kilogram
MSA	Metropolitan Statistical Area
msl	mean sea level
NASA	National Aeronautics and Space Administration

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

NCSHPO	National Conference of State Historic Preservation Officers
NEPA	National Environmental Policy Act
NHB	NASA Handbook
NHL	National Historic Landmark
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
ppm	parts per million
psia	pounds per square inch, absolute
SF ₆	Sulfur hexafluoride
R-12	Dichlorodifluoromethane
R-134a	1,1,1,2 Tetrafluoroethane
SIP	State Implementation Plan
TBT	Tributyl Tin
TDT	Transonic Dynamics Tunnel
TWA	Time-weighted Average
VOC	Volatile Organic Compound
% v/v	percent by volume

1.0 SUMMARY AND CONCLUSIONS

The proposed action is intended to support the National Aeronautics and Space Administration's (NASA) commitment to phase out chlorofluorocarbons (CFC) at the Langley Research Center's (LaRC) Transonic Dynamics Tunnel (TDT) in Hampton, Virginia. CFCs have been identified as a major cause of stratosphere ozone depletion. The TDT is the only facility in the world that provides the capabilities for studying a full range of aeroelastic (i.e., the flexibility of aircraft in flight) phenomena at transonic speeds. This facility uses dichlorodifluoromethane (R-12), a CFC, as the primary test medium. The benefits of using heavy gases such as R-12 as a test medium at the TDT necessitate replacing the R-12 with an alternative heavy gas, which is not a CFC.

The proposed action calls for replacing R-12 with 1,1,1,2 tetrafluoroethane (R-134a), a hydrofluorocarbon, as the heavy gas test medium at the TDT. This involves removing the R-12 from the TDT, making modifications to certain systems within the TDT to accommodate R-134a, and operating the TDT with R-134a as the heavy gas test medium. The TDT currently uses a heavy gas recovery system to separate R-12 from the air/gas mixture prior to venting the tunnel. The existing heavy gas recovery system uses compression and condensation to liquify and recover R-12 from the air/gas mixture. Modifications to the existing heavy gas recovery system are needed to accommodate the differences between R-12 and R-134a.

The proposed action, the No-Action Alternative, and the use of an alternative replacement heavy gas (i.e., sulfur hexafluoride [SF_6]) were considered in this Environmental Assessment (EA). The No-Action Alternative entails using no replacement heavy gas and operating the TDT using air as the test medium. This alternative would not provide the needed capabilities for aeroelastic testing at the TDT. The alternative replacement heavy gas, SF_6 , is suitable for use in the TDT, but would require major equipment changes to the heavy gas recovery system and storage tank. Also, SF_6 has the environmental drawback of being a greenhouse gas, one that has a high global warming potential.

The environmental analysis indicates that the proposed action will not have a significant impact on local natural, cultural, and socioeconomic resources. Any potential hazardous and toxic wastes resulting from facility upgrades would be disposed of in accordance with applicable Federal, State, and local regulations.

Based on the evaluation presented in this EA, the potential environmental impacts associated with the proposed replacement of R-12 with R-134a in the TDT will not individually or cumulatively be significant. A Finding of No Significant Impact (FONSI) is recommended.

2.0 PURPOSE AND NEED

2.1 PROJECT BACKGROUND

The Langley TDT (Building 648) is the only facility in the world that provides the capabilities for studying a full range of aeroelastic phenomena. The TDT tests scaled models at transonic speeds up to 1,368 kilometers (km) (850 miles) per hour for air and 689 km (428 miles) per hour for R-12. This test facility provides a means of evaluating aeroelastic phenomena without the use of extensive, costly, and high-risk flight testing of an actual aircraft by a test pilot. Testing scale models in the TDT enables the aeroelastic characteristics of a new vehicle to be determined early in the design process. These tests allow design changes to be made in a cost-effective manner.

The Langley TDT uses a heavy gas, R-12, as the primary test medium. This gas has a density four times that of air which allows for the use of heavier (i.e., stronger) test models, and a speed of sound half that in air which reduces model frequencies by a factor of two. The high density and low speed of sound facilitate the design and fabrication of scaled models that accurately represent operation of their full-scale counterparts in the atmosphere. A further advantage of using a heavy gas medium over air in the TDT is the need for less than half the electrical drive power to achieve the same test conditions. Furthermore, the high density and low speed of sound yield a higher Reynolds number and enable simulation of other parameters that cannot be properly scaled for testing in air.

R-12 belongs to a family of chemicals known as CFCs which have been commonly used in refrigerators, air conditioners, aerosol propellants, industrial solvents, and in the manufacture of plastic foam. Since the mid-1970s, the release of CFCs into the atmosphere has been increasing rapidly and concern exists over the environmental effects associated with CFC release, specifically the effect of CFCs on the ozone layer. Because CFCs do not decompose within the troposphere (i.e., lower atmosphere), they are transported upwards to the stratosphere where they are photodissociated by ultraviolet radiation from the sun releasing free chlorine atoms known to destroy ozone. In addition, because R-12 has a greater ability to absorb solar radiation than the natural atmosphere, it is a potential contributor to global warming (i.e., a "greenhouse gas").

In 1987, the Montreal Protocol was established among 24 nations including the United States, Japan, and members of the European Economic Community to restrict the production and consumption of CFCs. The Montreal Protocol, which called for an end to the production and use of CFCs by the end of the century, was ratified by the United States in 1988. In response to the Montreal Protocol, LaRC proposed a two-phase solution to the use of R-12 in the TDT. Phase 1 was to modify the heavy gas recovery system to minimize the loss of R-12 to the atmosphere; Phase 2 was to replace R-12 with an alternate, environmentally acceptable, heavy gas. Phase 1 has been completed. NASA LaRC has a continuing program to monitor and reduce heavy gas leakages from TDT. Phase 2 was originally scheduled to be completed by the end of the century in accordance with the timeframe specified by the Montreal Protocol. However, a Presidential Executive Order in 1992, as implemented through the Environmental

Protection Agency (EPA) regulations, required that the United States cease production of CFCs by the end of 1995, necessitating acceleration of the TDT Phase 2 schedule (Sverdrup Technology, Inc., March 1994).

In December 1992, LaRC initiated an engineering study to evaluate alternative heavy gases for use at the TDT, and to evaluate the heavy gas recovery process for such alternatives. These studies identified a hydrofluorocarbon (R-134a) and SF₆ as the best candidates to replace R-12. Although SF₆ is more desirable from an aerodynamic viewpoint, NASA LaRC has selected R-134a for the TDT because of its benign environmental properties. R-134a has been shown to be non-toxic, non-corrosive, and non-flammable under normal tunnel-operating conditions (less than 101 kilopascals [kPa] or 14.7 pounds per square inch absolute [psia] pressure and less than 60°C [140°F]). R-134a has also been shown to have no ozone-depletion potential, and minimal global warming potential (Table 2-1). Further studies showed that the existing TDT heavy gas recovery system could efficiently recover R-134a without major modifications (Sverdrup Technology, Inc., February 1994).

2.2 PROJECT OBJECTIVE

The objective of the proposed action is to replace R-12 with an environmentally benign heavy gas as the test medium at the TDT. As explained in Section 2.1, NASA has committed to replacing R-12 in accordance with the accelerated schedule specified in the Presidential Executive Order on CFC phase-out. Given the uniqueness of and the high demand for testing in the TDT, the replacement of R-12 must be accomplished in as timely a manner as possible.

2.3 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA addresses the environmental issues related to removing R-12 from the TDT and operating the TDT with R-134a as the heavy gas test medium. This EA was prepared in accordance with the following regulations:

Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) (40 Code of Federal Regulations [CFR] Parts 1500-1508, 1978);

NASA's regulations implementing the provisions of NEPA (14 CFR Subpart 1216.3, 1988) as addressed in Implementing the Provisions of the National Environmental Policy Act, NASA Handbook (NHB) 8800.11; and

Langley Handbook (LHB) 8800.1, LaRC Environmental Program Manual.

TABLE 2-1
COMPARISON OF PROPERTIES OF R-12, R-134a, AND SF₆

Properties	R-12	R-134A	SF₆
Molecular Weight	121	102	146
Freezing Point, °C (°F)	-158 (-252)	-103 (-154)	-50 (-59)
Density			
at 25°C (77°F) (Liquid), lb/cf	82	75	84
at 1 atmosphere (atm) (Vapor), lb/cf	0.31	0.27	0.38
Vapor Pressure at 25°C (77°F), psia	95	97	344
Speed of Sound at 100°F and 1 atm, feet per second (fps)	502	542	453
Combustibility Limits, percent by volume (%v/v) @400 psia	none	8 to 42	none
Heat of Vaporization, British thermal unit (Btu)/lb @1 atm	71	93	66
Ozone Depletion Potential	1.0	0	0
Halocarbon Global Warming Potential	3.2	0.26	3
Toxicity Acceptable Exposure Level (AEL) (8-and 12-hr time-weighted average [TWA]) ppm	1,000	1,000	1,000

Source: Sverdrup Technology, Inc., March 1994

3.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

3.1 NASA LANGLEY RESEARCH CENTER

NASA LaRC is located in the city of Hampton in southeastern Virginia (Figure 3-1). LaRC encompasses approximately 327 hectares (807 acres) divided into an East Area and a West Area, and consists of numerous facilities providing specialty support to aerospace research and testing.

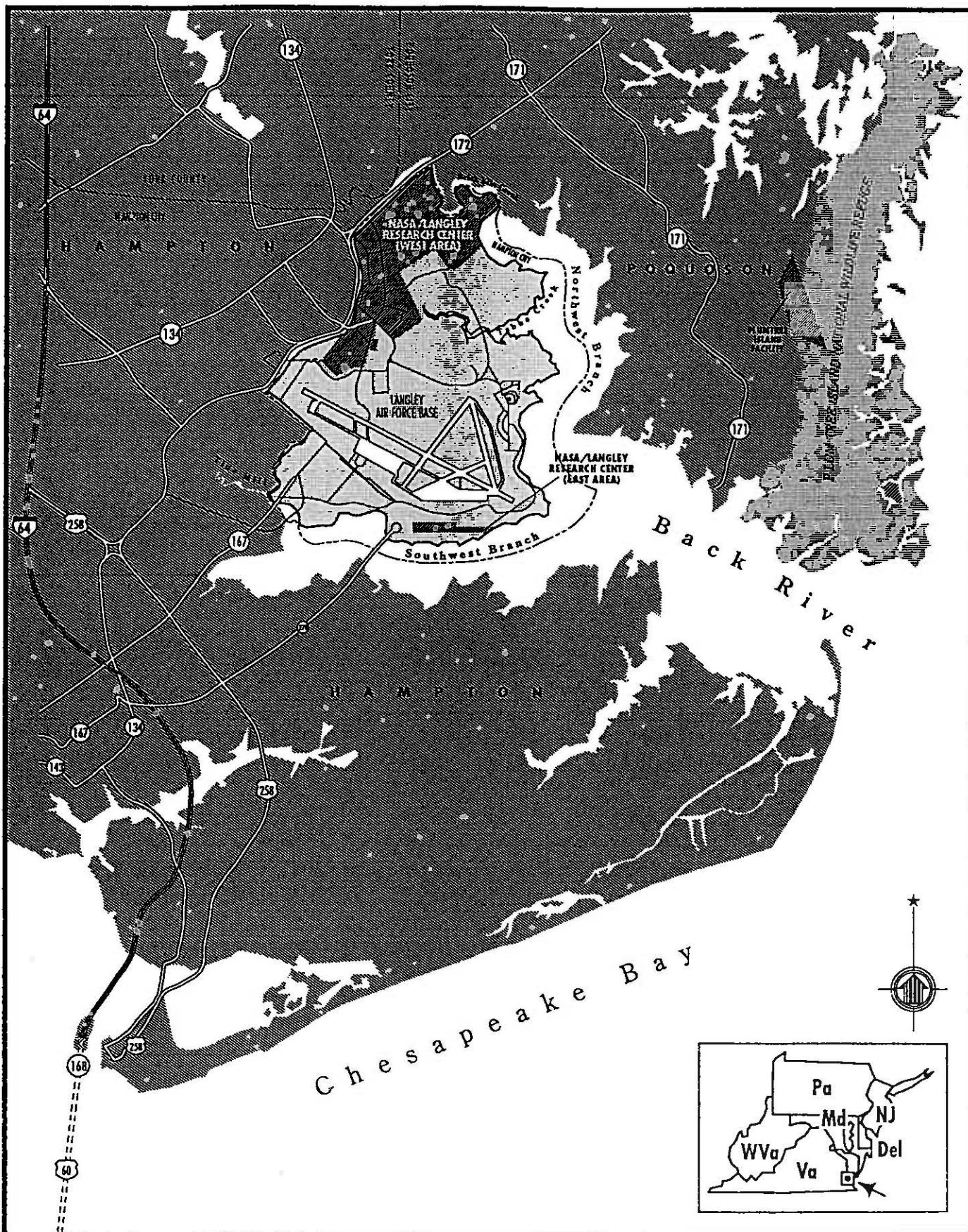
3.2 TRANSONIC TEST FACILITY

Building 648, which is located in the East Area of LaRC (Figure 3-2), was constructed in the mid-1930s and operated as the Langley 19-Foot Pressure Tunnel. The need for wind-tunnel facilities within the United States for testing aeroelastic phenomena led to the conversion of the Langley 19-Foot Pressure Tunnel to a large transonic wind tunnel with the capabilities for studying the dynamics and aeroelastic problems of high-speed aircraft. The TDT became fully operational using heavy gas in 1960 and has served ever since as a "National Facility" dedicated almost exclusively to the understanding of aeroelasticity and addressing related issues for airplanes, rotorcraft, and space launch vehicles.

The TDT is a large, closed-circuit wind tunnel having a volume of 28,000 cubic meters (m^3) (1 million cubic feet [ft^3]). The TDT has a 4.9 m by 4.9 m (16-ft by 16-ft) test section. This facility is driven by a 30,000-horsepower (hp) electric motor that can operate the tunnel continuously at transonic speeds up to 1.2 Mach number, and under pressures ranging from atmospheric to subatmospheric (0.01 atm). The TDT can be operated with either air or a heavy gas (i.e., R-12) as the test medium (NASA LaRC, 1969).

A large percentage of the testing (95 percent) in the TDT is performed using R-12 as the test medium. Up to 136,077 kg (300,000 lb) of R-12 may be charged into the tunnel for testing. R-12 is stored as a liquid in an onsite storage tank having a capacity of 172,364 kg (380,000 lb). Prior to being charged into the tunnel, R-12 is vaporized with a steam-heat exchanger that converts the liquid to a gaseous state. Gaseous R-12 is injected at the bottom of the tunnel while air is removed from the top. The mixing layer between the air and R-12 is drawn off and run through the heavy gas recovery system which compresses and condenses the R-12 to a liquid and returns it to the heavy gas storage tank. The system effectively separates the air/R-12 mixture, exhausting a gas stream containing no more than 200 parts per million (ppm) R-12.

When switching the tunnel from the heavy gas to air, R-12 is removed from the tunnel by reversing the above process. Gaseous R-12 is pumped from the bottom of the tunnel and passed through the heavy gas recovery system to recover the gas. As the R-12 is pumped from the tunnel, air is introduced at the top to facilitate removal of the remainder of the R-12. The mixing layer between the air and R-12 is pumped from the tunnel through the heavy gas recovery system to collect any remaining R-12. Again, the exhausted gas contains less than 200 ppm R-12. More than 99.5 percent of the R-12 introduced into the tunnel to perform a series of tests is recovered for reuse in subsequent testing.



EBASCO SERVICES, INC.

Location of
NASA Langley Research Center
Hampton, Virginia

Figure 3-1

It is not necessary to convert the entire tunnel circuit from R-12 to air to perform model changes. The plenum and test section region can be isolated from the remainder of the test circuit, allowing worker access to the model area without the necessity of returning the entire tunnel to an air environment. The volume of the test section is about 7,000 m³ (250,000 ft³).

For over three decades, the unique capabilities of the TDT have been applied to a great variety of aeroelastic investigations. The vast majority of U.S. military high performance aircraft, civilian transport aircraft including the National Aerospace Plane, and space launch vehicles including the space shuttle, have been tested in the TDT. The TDT maintains a two-year minimum test backlog. This facility normally operates two, eight-hour shifts per day. Tests normally last for three to four weeks, and a model may return to the TDT three to four times for additional testing depending upon design issues encountered. The TDT is generally available for testing with heavy gas 33 weeks per year. Forty-nine persons are currently assigned to the TDT. Of this compliment, 10 to 15 persons are required for a test depending upon the complexity.

3.3 PROPOSED ACTION

The proposed action calls for removing R-12 from the TDT, modifying specific components of the TDT to accommodate R-134a, and operating the facility using R-134a instead of R-12 as the heavy gas test medium.

3.3.1 Removing R-12

It is estimated that about 81,000 kg (180,000 lb) of R-12 will need to be removed from the R-12 storage tank and supply system prior to the introduction of R-134a (Sverdrup Technology, Inc., February 1994). It is anticipated that the R-12 will be removed from the storage tank, lines, and equipment by an industrial gas supplier and taken off-site for reuse or disposal. The R-12 will be removed as a liquid, re-venting any gas back into the tank. Gaseous R-12 will then be removed from the storage tank through a scavenging system. The storage tank will be purged with dry nitrogen gas (GN₂) and any necessary repairs will be made to the tank prior to filling with R-134a. R-12 removal is scheduled to occur approximately in May 1996.

3.3.2 Modification of the TDT to Accommodate R-134a

No changes are necessary to the TDT itself to accommodate R-134a. The TDT has an ongoing program to identify and eliminate sources of heavy gas losses. This program will continue. Additional piping and associated valves will be added to improve the ability to collect heavy gas from the tunnel and more effectively transfer it to the reclamation system. Gas analyzers will be installed to help determine potential causes of heavy gas losses.

Given the higher freezing point of R-134a compared to R-12 (see Table 2-1) and the combustibility of pressurized air/R-134a mixtures, modifications are needed to the heavy gas recovery system to accommodate R-134a. The existing heavy gas recovery system consists of six large blowers, a five-stage Clark reciprocating compressor, and a nitrogen-cooled, low-

temperature condensing system. The Clark compressor will undergo the following modifications to accommodate R-134a: (1) control of the compression ratio of the compressor to minimize the potential for creating a combustion condition; (2) installation of additional pressure and temperature sensors; (3) modification of piping to reduce vibrations; and (4) installation of special fugitive-type emission rod seals with a scavenge and purge system to return any gas leaks to the compressor inlet. Modifications will be made to the fill station on the existing gas storage system, which was identified previously as one of the sources for gas loss. The electrical and control systems will be upgraded (Sverdrup Technology, Inc., March 1994). Figure 3-3 shows a layout of the TDT facility.

Construction of the proposed modifications to the heavy gas recovery system is scheduled for a one-year period beginning in March 1996. R-12 removal will begin around May 1996. The estimated construction cost of the conversion is \$7.9 million.

3.3.3 Operation of the TDT Using R-134a as the Heavy Gas Test Medium

No changes are anticipated to the present test schedules or number of employees at the TDT due to the conversion to R-134a. The quantity of R-134a needed for testing will be similar to that of R-12.

3.4 ALTERNATIVES

The alternatives considered in this EA are the proposed action described in the preceding section, the No-Action Alternative, and the use of an alternative heavy gas to replace R-12. Inclusion of the No-Action Alternative in an environmental analysis is prescribed by the CEQ Regulations Implementing the Procedural Provisions of the NEPA (40 CFR Parts 1500 - 1508). The No-Action Alternative typically consists of continuing the status quo, thereby serving as the benchmark against which the proposed action is evaluated. For this project, however, it will not be possible to continue the status quo of using R-12 as the heavy gas test medium because R-12 will no longer be manufactured in the U.S. after 1995. Consequently the No-Action Alternative evaluated in this EA consists of discontinuing the use of heavy gas and performing all testing with air as the test medium. Use of SF₆ as the alternative replacement heavy gas is evaluated in this EA.

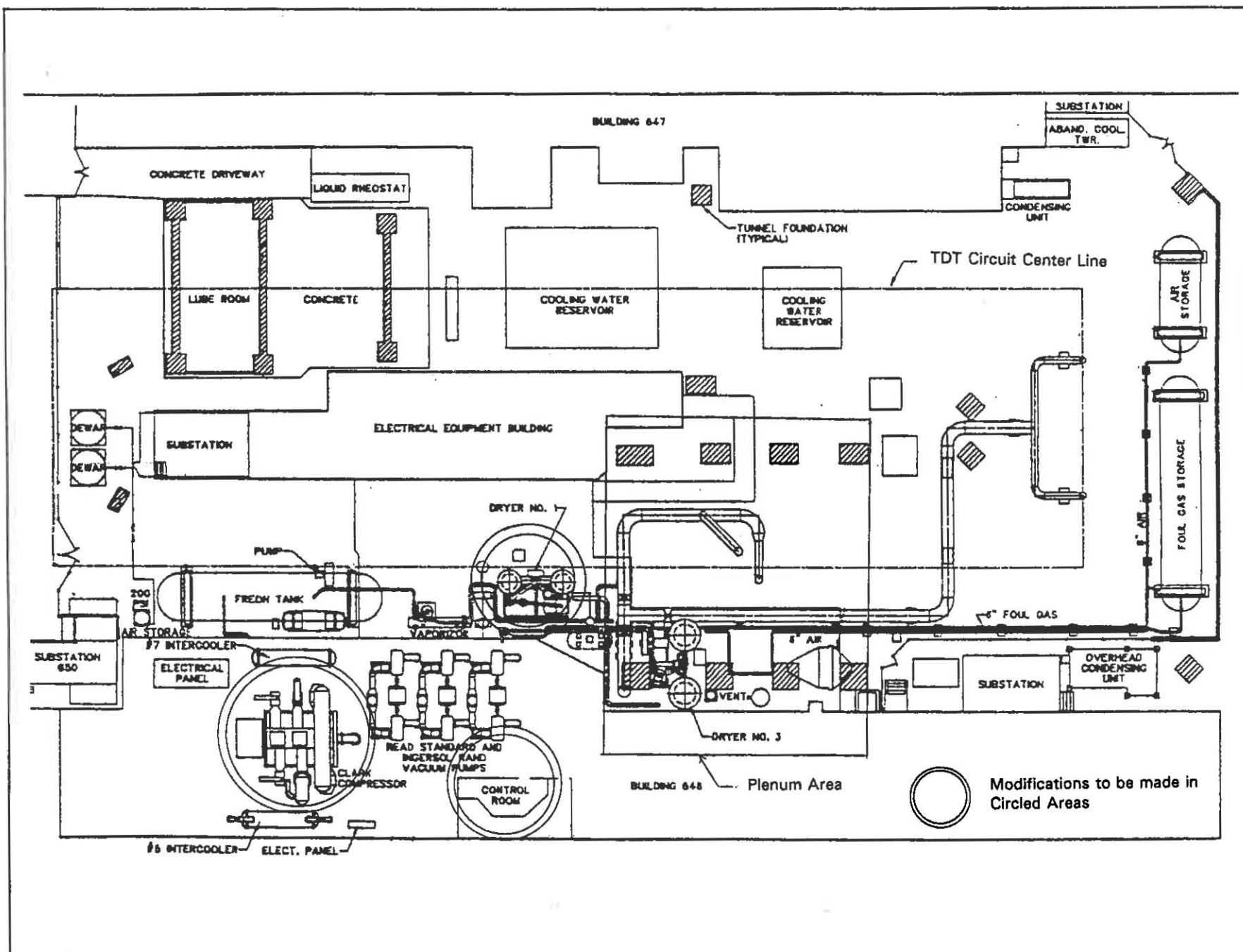


Figure 3-3. General Layout of TDT

4.0 ENVIRONMENTAL IMPACTS

4.1 PROPOSED ACTION

As described in Section 3.3, the proposed action evaluated in this EA consists of: (1) removing the R-12 from the TDT, (2) making modifications to the existing TDT heavy gas recovery system to accommodate R-134a, and (3) operating the TDT with R-134a as the heavy gas test medium.

4.1.1 Land Use

No land clearing is anticipated for the proposed project. All facility construction and modifications will be carried out inside existing building structures. The TDT is located in an area of NASA LaRC where other similar facilities are located. Hence, no impact to existing land use is anticipated.

4.1.2 Water Quality

Implementation of the proposed action will not result in any change in the use of potable or process water at the facility. The proposed action will not result in a change in the quantity or quality of wastewater released from the facility.

4.1.3 Air Quality

Air Emissions

Emissions of heavy gas from the TDT presently occur (1) as fugitive leakages from the tunnel system, and (2) in the effluent from the heavy gas recovery system. There is no direct consumption of R-12 in performing a test.

R-12 losses occur when the tunnel environment is switched from air-to-R-12 or R-12-to-air. As described in Section 3.2, the plenum must be switched to an air environment before the model can be accessed during testing. Model access normally occurs once or twice per day during testing, which means that the plenum environment must be switched from R-12-to-air-to-R-12 once or twice a day. The entire tunnel system is converted to an air environment at the end of each week of testing, and back to an R-12 environment at the start of the next week of testing. R-12 losses during these conversions result from leaks and from accumulations of R-12 in sections of the tunnel that are not readily transferred into the heavy gas reclamation system. When the tunnel is switched to an air environment, the space is left open to the atmosphere allowing the residual R-12 to escape.

Fugitive emissions from the TDT are estimated to be up to 454 kg (1,000 lb) of R-12 per week of testing. At 33 test weeks per year, this results in a maximum loss of 14,968 kg (33,000 lb) per year. R-12 losses in the effluent from the heavy gas recovery system are considerably smaller and are estimated at less than 907 kg (2,000 lb) per year.

Under the present tunnel conditions, fugitive emissions of R-134a will be similar to R-12. However, as stated in Section 3.3.2, LaRC will continue to identify and remedy sources of heavy gas losses in the TDT recovery system. One such modification under consideration is to purge areas of the tunnel, where heavy gas tends to accumulate, into the heavy gas recovery system by adding piping.

The effluent from the heavy gas recovery system will have a maximum R-134a concentration of 1,000 ppm, although currently it is anticipated that the operational efficiency of the system will effect an effluent concentration of 200 to 300 ppm. Considering the worst-case effluent concentration of 1,000 ppm over a 33-week test cycle, R-134a emissions in the effluent would be 816 kg (1,800 lb) per year.

Final removal of R-12 from the TDT and return to the liquid storage tank will be carried out using the existing heavy gas reclamation system and will not result in any substantial increase in releases to the atmosphere. The R-12 in the liquid storage tank will be removed and transported off-site by the contractor and reused or disposed in compliance with State and Federal regulations.

Regulatory Requirements

R-134a is an exempt volatile organic compound (VOC), as defined in Part I Section 120-01-02 of the Virginia Air Regulations. Consequently, the ozone nonattainment provisions of Title I of the Clean Air Act are not applicable. The Occupational Health and Safety Administration (OSHA) or the American Conference of Governmental Industrial Hygienists (ACGIH) establish toxicity Allowable Exposure Level (AEL) for all chemicals with an 8- and 12-hour time weighted average (TWA). However, no such AELs have, yet, been established for R-134a. The manufacturer, DuPont, has assigned an AEL value of 1,000 ppm (see Table 2-1) for R-134a to protect users from extended exposure. R-134a is not considered a hazardous air pollutant under current Virginia Department of Environmental Quality (DEQ)-Air Division regulations (personal communication, Ms. Donna Huang, DEQ, April 14, 1995). Hence, the proposed operation of the TDT with R-134a as the heavy gas test medium will not violate any provisions adopted in the Virginia State Implementation Plan (SIP).

4.1.4 Noise

No increases in noise levels produced by the compressor and piping are anticipated from using R-134a instead of R-12. Such noise will be contained within the interior of Building 648 as under current operations. The noise will not be audible at any residential receptors.

4.1.5 Waste Generation, Treatment, Storage, and Disposal

Non-hazardous solid waste generated at LaRC is disposed of by burning in the refuse-to-steam generating facility located in Building 1288, or by disposal in an off-site, permitted landfill. Construction debris from the proposed action will be disposed of in an off-site, permitted landfill. The contractor for installation of system modifications will be required to identify any

hazardous waste generated during construction and to submit a hazardous waste disposal plan which will be approved by the NASA Contracting Officer prior to disposal.

The proposed action will not affect the quantity, type or the disposal of solid waste generated from the TDT operation. The TDT does not generate any hazardous wastes and the proposed action will not result in the generation of any hazardous waste during operation of the facility. The existing R-12 gas will be removed and reclaimed by the industrial gas supplier to be reused or disposed of in accordance with State and Federal regulations.

4.1.6 Toxic Substances

A survey of Building 648 indicated that there are no asbestos-containing materials in the areas that will be disturbed by the proposed modifications. Any toxic substances encountered during the proposed component modifications will be managed in accordance with appropriate Federal, State, and local regulations, the Langley Facility Safety Requirements, (LHB 1740.2), and LHB 8800.1.

The R-12 will be removed from the storage tank, lines, and equipment by an industrial gas supplier and reused or disposed of off-site as described in Section 4.1.4.

4.1.7 Radioactive Materials and Non-ionizing Radiation

Operation of the proposed action will not require the use of and will not produce radioactive materials or non-ionizing radiation. During construction, x-ray examination of piping welds will be performed in accordance with the Langley Facility Safety Requirements, Ionizing Radiation (LHB 1710.5). This is a standard, quality assurance procedure for non-destructive examination of welds.

4.1.8 Biological Resources

The biological resources of LaRC are described in the facility Draft Environmental Resources Document (Ebasco, 1994). There are no natural habitats in the vicinity of the tunnel facility. Because the proposed action will not excavate any areas outside of the facility, no impacts to biological resources at LaRC are anticipated.

4.1.9 Endangered and Threatened Species

A comprehensive biological field survey has been initiated at LaRC; preliminary results are anticipated in Fiscal Year (FY) 1995. A review of the Virginia Natural Heritage Program database indicates that no Federal or State-listed endangered or threatened species are known to occur at LaRC (Letter from the Virginia Department of Conservation and Recreation's Division of Natural Heritage dated January 21, 1993 - Appendix A). The proposed action will occur in an industrial area of LaRC devoid of suitable natural habitat and will not affect any listed or proposed endangered or threatened species or their critical habitat.

4.1.10 Wetlands and Floodplains

LaRC has large areas of tidal wetlands associated with Brick Kiln Creek and Tabbs Creek, and small, scattered areas of forested wetlands. No wetlands occur in the vicinity of Building 648. The proposed action will not affect any wetlands at LaRC.

The 100-year floodplain elevation at LaRC is 2.6 m (8.5 ft) above mean sea level (MSL). The facility is within the 100-year floodplain elevation. Hazardous substances are stored above the 100-year floodplain inside the facility. Critical systems and components are also located above the 100-year floodplain.

4.1.11 Coastal Resources Management

The city of Hampton is a tidewater jurisdiction under the Commonwealth of Virginia's approved Coastal Resources Management Program (CRMP). The Virginia CRMP is a networked program based upon existing State licenses, permits, and approval requirements (Table 4-1).

In implementing the CRMP, the Virginia DEQ-Division of Public and Intergovernmental Affairs considers an activity to affect the coastal zone if it requires a permit or approval under any of the networked programs. The activity is considered to be consistent with the CRMP if it is consistent with all applicable programs (i.e., receives all applicable state licenses, permits, and approvals). The only programs applicable to the proposed TDT modifications are the non-point source pollution control and point source pollution control (the National Pollutant Discharge Elimination System [NPDES] permit program). No land-clearing or construction activities outside the existing facility will be required for the action and no change in wastewater effluents are anticipated with the proposed action. Consequently the proposed action is consistent with the Virginia CRMP.

4.1.12 Historic, Archeological, and Cultural Factors

NASA LaRC has a Programmatic Agreement among the National Conference of State Historic Preservation Officers (NCSHPO) and the Advisory Council on Historic Preservation (ACHP) (signed September 20, 1989) which addresses agency consultation and mitigation on projects which through demolition, alteration, or new construction affect facilities designated as National Historic Landmarks (NHLs). A portion of LaRC has been inventoried for buildings which may be considered to be historically significant; inventory of the remainder of the Center is ongoing. Archeological surveys have been performed at various locations throughout LaRC, and a Center-wide predictive analysis of potential archeological resources is under contract with the Army Corps of Engineers (ACOE).

To date, five structures at LaRC have been identified as NHLs. LaRC is developing a Cultural Resources Management Plan under the direction of the Facility Preservation Officer. This Plan will be based upon information obtained from the previous archeological surveys and building inventories within LaRC as well as from the Center-wide archeological survey and building

TABLE 4-1
PROGRAMS COMPRISING VIRGINIA'S COASTAL
RESOURCES MANAGEMENT PROGRAM

Program	Administering Agency
Fisheries Management	Marine Resources Commission Department of Game and Inland Fisheries
State Tributyltin (TBT) Regulatory Program	Marine Resources Commission Department of Game and Inland Fisheries Department of Agriculture and Consumer Services
Subaqueous Lands Management	Marine Resources Commission
Wetlands Management	Marine Resources Commission
Dunes Management	Marine Resources Commission
Non-point Source Pollution Control	Department of Conservation and Recreation
Point Source Pollution Control NPDES Permit Program Water Quality Certification under Section 401 of Clean Water Act	Department of Environmental Quality-Water Division
Shoreline Sanitation	Department of Health
Air Pollution Control	Department of Environmental Quality-Air Division

inventories. The Plan will specify zones of cultural resources potential and will establish a Historic District within LaRC.

Building 648 was constructed in the 1930s and is not considered to possess historic or architectural significance to be designated an NHL subject to the provisions of the referenced Programmatic Agreement. The proposed action does not involve any change to the building exterior or excavation outside the facility. Therefore, the action is not expected to affect the historical and archeological resources of LaRC.

4.1.13 Economic, Population, and Employment Factors

LaRC is located in the northern portion of the city of Hampton in the southern Peninsula Area of southeastern Virginia. LaRC is in the central portion of the Hampton Roads Metropolitan Statistical Area (MSA) which consists of the Virginia cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg; the Virginia

counties of Gloucester, Isle of Wight, James City, Matthews, and York; and Currituck County, North Carolina.

The population of the city of Hampton was about 135,000 in 1991, while the entire Hampton Roads MSA had a population of 1,431,088. The 1980 population for this area was 1,187,846, which represents a 19.4 percent increase in population in 10 years. The Hampton Roads MSA work force consisted of 643,120 civilian and 141,000 active duty military in 1991 (Hampton Roads Planning District Commission, 1993).

LaRC presently employs approximately 3,000 civil service and 2,200 contractors, with an annual payroll of \$153 million. LaRC contracts about \$409 million annually in goods and services both locally and nationally, thus performing an important role in the local economy.

The TDT currently has a staff compliment of 49 which is not anticipated to change with the proposed action. A capital expenditure of about \$7.9 million over a two-year period for TDT modification is not expected to significantly affect the local economy.

4.1.14 Traffic and Parking

Project installation activities will not significantly displace existing parking near Building 648. There may be minor traffic restriction near the building when R-12 is being removed from the tunnel. No significant long-term traffic or parking impacts are expected. Operation of the facility using R-134a will not be different from current operations.

4.1.15 Energy

The TDT is a major electricity user and is covered by the LaRC-wide energy management program for energy conservation and efficient usage. The proposed action will not affect the electricity usage at the facility.

4.1.16 Safety

R-134a/air mixtures are combustible under certain high-pressure and temperature conditions. Testing in the TDT is carried out at or below atmospheric pressure and, therefore, does not raise the possibility of combustion in the tunnel. However, the heavy gas recovery system operates at pressures up to 415 psia and temperatures around 177°C (350°F) in the compressor cylinders. LaRC has conducted studies to determine the potential for combustion of R-134a/air mixtures in the compressor under normal working conditions. Since there are no heaters or electrical components within the heavy gas recovery system which could provide energy to ignite the air/gas mixture, the only identified failure which could cause ignition would be a failed valve in the compressor system resulting in a slow build-up of gas temperature in the compressor cylinders. These studies indicate that at 177°C (350°F) (the maximum recommended gas temperature in the Clark compressor), R-134a/air mixtures with R-134a concentrations between 8 and 42 percent are combustible under pressures above 100 psig when exposed to a high energy ignition source. During normal operation of the TDT, heavy gas recovery system air/gas

mixtures with the above concentrations of R-134a and air occur for about one to two minutes while the tunnel transitions between the air and heavy gas environment. The studies also indicated that probability of ignition of the air/gas mixture within the Clark compressor to be 8.2×10^{-8} per 2,000 hours of compressor operation (Sverdrup Technology, Inc, February 1994).

LaRC has conducted studies to determine the auto-ignition temperature of R-134a/air mixtures. Preliminary results have indicated auto-ignition temperatures for R-134a to be above 282°C (540°F). These temperatures are outside the normal operating range of the Clark compressor.

NASA LaRC will develop and implement design features to eliminate or minimize any risk of combustion of the R-134a/air mixture in the TDT system. As described in Section 3.3.2, the proposed action calls for installing additional pressure and temperature sensors in the Clark compressor to detect pressure and temperature changes that could signal a system failure. Monitoring pressure and temperature conditions within the compressor would enable early detection of a potential incident, and would provide for automatic system shutdown. In the unlikely event of combustion within the Clark compressor, the structural design of the cylinders would contain the increased pressures, maintaining the integrity of the compressor system. While this might result in some internal equipment damage, there would be no effect on personnel safety.

Besides the combustibility issue, the risks of using R-134a are similar to those associated with using R-12. Both have the same toxicity AEL with an 8- and 12-hour TWA of 1,000 ppm (see Table 2-1). The AEL has been established by the manufacturer in the absence of such determinations by the OSHA or the ACGIH. The TDT has a detection/alarm system which monitors the building and plenum for the presence of heavy gas. The existing heavy gas detectors will be modified for use with R-134a. LaRC has an established evacuation plan in case of a mishap dealing with a heavy gas leak that would be appropriately modified to include the use of R-134a. In view of the above, no significant safety issues are anticipated with TDT conversion to R-134a.

4.1.17 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires Federal agencies to identify and address the potential for their programs, policies, and actions to have disproportionately high and adverse human health or environmental effects on minority or low-income populations. The companion Presidential Memorandum, signed February 11, 1994, directs Federal agencies to include in their NEPA documents an analysis of the effects of their actions on minority and low-income communities, along with mitigation measures for significant and adverse effects.

As addressed in the previous sections, the proposed action will comply with all applicable environmental statutes and regulations. Insofar as the proposed TDT conversion to the use of R-134a is not anticipated to have significant environmental or socioeconomic effects, the proposed action will not have disproportionately high or adverse human health or environmental effects on minority or low-income populations.

4.2 NO-ACTION ALTERNATIVE

The No-Action Alternative typically consists of continuing the status quo, thereby serving as the benchmark against which the proposed action is evaluated. For this project, however, it will not be possible to continue the status quo of using R-12 as the heavy gas test medium because R-12 will no longer be manufactured in the U.S. after 1995. Consequently, the No-Action Alternative evaluated in this EA consists of discontinuing the use of heavy gas and performing all testing with air as the test medium.

Operation of the TDT with air as the test medium does not provide the capabilities for performing most aeroelasticity testing. A heavy gas medium is needed to provide high density and lower speed of sound for model testing that will accurately reflect the full-scale vehicle performance. With air as the test medium, most of the scale models would be too flimsy to withstand the tunnel test conditions. Without such testing capability, the U.S. would lose its edge on aeroelasticity research which would compromise the commercial viability of U.S. aircraft manufacturers.

4.3 ALTERNATIVE HEAVY GAS REPLACEMENT

From a testing standpoint, the heavy gas SF_6 would be a more appropriate candidate replacement gas than R-134a because of its higher density which would provide for greater test efficiency. However, SF_6 has significant operational and environmental drawbacks which inhibited its selection as a replacement gas at the TDT. SF_6 has a significantly higher freezing point than R-134a (-50°C [-59°F] versus -103°C [154°F]) which would make it more difficult to recover through condensation within the heavy gas recovery system. SF_6 also has a higher vapor pressure than R-134a which affects its storage in the on-site storage tank. Major equipment changes would be required to the heavy gas recovery system and to the storage tank to accommodate SF_6 . From an environmental standpoint, SF_6 has the additional drawback of being a greenhouse gas.

5.0 REFERENCES

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NASA Langley Research Center, September 1994. Facility Safety Requirements, LHB 1740.2.

Sverdrup Technology, Inc., February 1994. First Phase Safety Engineering Study on Risk of Combustion in the Clark Compressor Adjunct to the NASA LaRC Heavy Gas Replacement Study. Prepared for NASA LaRC, Hampton, Virginia. Contract No. NAS1 - 19923.

Sverdrup Technology, Inc., March 1994. Preliminary Engineering Report for Modifications Required to Convert the Transonic Dynamics Tunnel (TDT) Heavy Gas Test Medium From R-12 to R-134a (Building 648). Prepared for NASA LaRC, Hampton, Virginia. Contract No. NAS1-19923 (A-E).

6.0 LIST OF AGENCIES CONSULTED

During preparation of this EA, the following agencies were consulted:

U.S. Fish & Wildlife Service

Commonwealth of Virginia Department of Environmental Quality

Commonwealth of Virginia Department of Conservation and Recreation

7.0 AGENCIES RECEIVING A COPY OF THE ENVIRONMENTAL ASSESSMENT

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NATURAL HERITAGE RESOURCES WITHIN LARC REGION

APPENDIX A



ADMINISTRATION
NATURAL HERITAGE
PLANNING AND RECREATION RESOURCES
SOIL AND WATER CONSERVATION
STATE PARKS

COMMONWEALTH of VIRGINIA
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF NATURAL HERITAGE

Main Street Station, 1500 East Main Street — Suite 312

TDD (804) 786-2121 Richmond, Virginia 23219 (804) 786-7951 FAX: (804) 371-2674

June 17, 1994

Richard G. Taylor
Ebasco Environmental
2111 Wilson Boulevard, Suite 435
Arlington, Virginia 22201-3058

re: NASA Langley Research Center, Resources Management Document

Dear Mr. Taylor:

Thank you for contacting the Division of Natural Heritage for current information on the Langley Research Center, and natural heritage resources in the local area.

According to information in our files, there are no natural heritage resources documented from within the Langley Research Center. The absence of data does not necessarily mean that natural heritage resources do not exist on or adjacent to the study site, but rather that our files do not currently contain information to document their presence.

I have enclosed updated lists of natural heritage resources that have been documented on the Poquoson West, Newport News North, and Hampton USGS Quadrangles. All of these resources could occur at Langley in appropriate habitat, however, their presence can only be verified through field surveys. There are no natural heritage resources documented on the Poquoson East Quadrangle.

No fee has been assessed for providing this information update. DNH's Biological and Conservation Data System is constantly growing and being revised. Please contact DNH for an update on this natural heritage information if a significant amount of time passes before it is utilized.

An explanation of species rarity ranks and legal status abbreviations is enclosed for your reference.

Thank you for the opportunity to comment on this project.

Sincerely,

Sarah H. Holbrook
Acting Environmental Review Coordinator

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF THE POQUOSON WEST QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
* AMPHIBIANS					
AMBYSTOMA MABEEI	MABEE'S SALAMANDER	G4	S1		LT
AMBYSTOMA TIGRINUM	TIGER SALAMANDER	G5	S1		LE
HYLA GRATIOSA	BARKING TREEFROG	G5	S1		LT
* BIRDS					
IXOBRYCHUS EXILIS	LEAST BITTERN	G5	S2		
* COMMUNITIES					
ESTUARINE HERBACEOUS VEGETATION					
ESTUARINE SCRUB					
LOW HERBACEOUS WETLAND					
OLIGOTROPHIC SEASONALLY FLOODED					
HERBACEOUS VEGETATION					
OLIGOTROPHIC SEASONALLY FLOODED					
WOODLAND					
OLIGOTROPHIC SEMIPERMANENTLY					
FLOODED WOODLAND					
SUBMESOTROPHIC FOREST					
* NON-VASCULAR PLANTS					
SPHAGNUM MACROPHYLLUM VAR MACROPHYLLUM	LARGE-LEAF PEATMOSS	G3G4T3	S2		
* VASCULAR PLANTS					
BOLTONIA CAROLINIANA	CAROLINA BOLTONIA	G2Q	S2		
CUSCUTA INDECORA	PRETTY DODDER	G5	S2?		
ELEOCHARIS TENUIS VAR VERRUCOSA	SLENDER SPIKERUSH	G5T3T5	S1		
FIMBRISTYLIS PERPUSILLA	HARPER'S FIMBRISTYLIS	G2G3	S1	C2	LE
HOTTONIA INFLATA	FEATHERFOIL	G3G4	S2		
LYTHRUM ALATUM VAR LANCEOLATUM	LANCE-LEAVED LOOSESTRIPE	G5T?	SH		
SABATIA CAMPANULATA	SLENDER MARSH PINK	G5	S2		
TILLANDSIA USNEOIDES	SPANISH MOSS	G5	S2		

20 Records Processed

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF THE HAMPTON QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
* BIRDS					
CASMERODIUS ALBUS	GREAT EGRET	G5	S82SN4		SC
CHARADRIUS MELODUS	PIPING PLOVER	G3	S2	LT	LT
RYNCHOPS NIGER	BLACK SKIMMER	G5	S2		
STERNA ANTILLARUM	LEAST TERN	G4	S2		SC
* INVERTEBRATES					
CICINDELA DORSALIS DORSALIS	NORTHEASTERN BEACH TIGER BEETLE	G4T2	S2	LT	C
* OTHER					
CHAMPION TREE					
* VASCULAR PLANTS					
CUSCUTA INDECORA	PRETTY DODDER	G5	S2?		
DESMODIUM STRICTUM	PINELAND TICK-TREFOIL	G4	S2		
DESMODIUM TENUIFOLIUM	SLIM-LEAF TICK-TREFOIL	G3G4	S1		
IVA IMBRICATA	SEA-COAST MARSH-ELDER	G5?	S1S2		

Records Processed

DEPARTMENT OF CONSERVATION & RECREATION
DIVISION OF NATURAL HERITAGE

NATURAL HERITAGE RESOURCES OF THE NEWPORT NEWS NORTH QUAD

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
* AMPHIBIANS					
AMBYSTOMA MABEEI	MABEE'S SALAMANDER	G4	S1		LT
* REPTILES					
CROTALUS HORRIDUS ATRICAUDATUS	CANEBRAKE RATTLESNAKE	G5TUQ	S1		LE
* VASCULAR PLANTS					
CAREX LUPULIFORMIS	FALSE HOP SEDGE	G3G4Q	S1		
CYPERUS DIANDRUS	UMBRELLA FLATSEGE	G5	SH		
QUERCUS SHUMARDII	SHUMARD'S OAK	G5	S2		
TRILLIUM PUSILLUM VAR VIRGINIANUM	VIRGINIA LEAST TRILLIUM	G3T2	S2	C2	

Records Processed

Definition of Abbreviations Used on Natural Heritage Resource Lists
of the
Virginia Department of Conservation and Recreation

Natural Heritage Ranks

The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHR's," are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The primary criterion for ranking NHR's is the number of populations or occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of populations or occurrences such that ranks will be an index of known biological rarity.

- S1 Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- S2 Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- S3 Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4 Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- SB# Breeding status of an organism within the state.
- SE Exotic; not believed to be native in the state.
- SH Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- SN# Non-breeding status within the state. Usually applied to winter resident species.
- SR Reported from the state, but without persuasive documentation to either accept or reject the report.
- SU Status uncertain, often because of low search effort or cryptic nature of the element.
- SX Apparently extirpated from the state.
- SZ Long distance migrant whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.

Global ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a character. Note that GA and GN are not used and GX means apparently extinct. A "Q" in a rank indicates that a taxonomic question exists concerning that species. A "?" in a rank indicates uncertainty as to that species' rarity. Ranks for subspecies are denoted with a "T". The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

These ranks should not be interpreted as legal designations.

Federal Legal Status

The Division of Natural Heritage uses the standard abbreviations for Federal endangerment developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation.

- | | |
|----------------------------|---|
| LE - Listed Endangered | 3A - Former candidate - presumed extinct |
| LT - Listed Threatened | 3B - Former candidate - not a valid species under current taxonomic understanding |
| PE - Proposed Endangered | 3C - Former candidate - common or well protected |
| PT - Proposed Threatened | NF - no federal legal status |
| C1 - Candidate, category 1 | |
| C2 - Candidate, category 2 | |

State Legal Status

The Division of Natural Heritage uses similar abbreviations for State endangerment.

- | | | |
|------------------------|----------------------------|----------------------|
| LE - Listed Endangered | PE - Proposed Endangered | SC - Special Concern |
| LT - Listed Threatened | PT - Proposed Threatened | |
| C - Candidate | NS - no state legal status | |

For information on the laws pertaining to threatened or endangered species, contact:

U.S. Fish and Wildlife Service for all FEDERALLY listed species
Department of Agriculture and Consumer Services Plant Protection Bureau for STATE listed plants and insects
Department of Game and Inland Fisheries for all other STATE listed animals

MATERIAL SAFETY DATA SHEET FOR R-134a

APPENDIX B



Du Pont Chemicals

2187FR



Revised 12-MAR-1994

Printed 7-APR-1994

"SUVA" COLD-MP

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

Corporate MSDS Number DU000693

CAS Number 811-97-2

Formula CH₂FCF₃

CAS Name 1,1,1,2-TETRAFLUOROETHANE

Tradenames and Synonyms

"SUVA" 134a

HFC 134a

Company Identification

MANUFACTURER/DISTRIBUTOR

DuPont

1007 Market Street

Wilmington, DE 19898

PHONE NUMBERS

Product Information 1-800-441-7515

Transport Emergency CHEMTREC: 1-800-424-9300

Medical Emergency 1-800-441-3637

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material

CAS Number %

811-97-2

ETHANE, 1,1,1,2-TETRAFLUORO- (HFC-134a)

100

(Continued)

HAZARDS IDENTIFICATION

Potential Health Effects

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness or death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite.

HUMAN HEALTH EFFECTS:

Overexposure by inhalation to very high concentrations may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation. Skin contact with the liquid may cause frostbite.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If high concentrations are inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

In case of contact, immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Call a physician. Treat for frostbite if necessary by gently warming affected area. Wash contaminated clothing before reuse.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

Ingestion is not considered a potential route of exposure.

Notes to Physicians

Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should only be used with special caution in situations of emergency life support.

(Continued)

FIRE FIGHTING MEASURES

Flammable Properties

Flash Point	Will not burn
Flammable limits in Air, % by Volume	
LEL	Not applicable
UEL	Not applicable
Autoignition	>743 C (>1369 F)

HFC-134a is not flammable at ambient temperatures and atmospheric pressure. However, HFC-134a has been shown in tests to be combustible at pressure as low as 5.5 psig at 177 deg C (351 deg F) when mixed with air at concentrations of generally more than 60 volume % air. At lower temperatures, higher pressures are required for combustibility. Experimental data have also been reported which indicate combustibility of HFC-134a in the presence of certain concentrations of chlorine.

Fire and Explosion Hazards:

Cylinders may rupture under fire conditions. Decomposition may occur.

Extinguishing Media

As appropriate for combustibles in area.

Fire Fighting Instructions

Cool cylinders with water spray. Self-contained breathing apparatus (SCBA) may be required if cylinders rupture or release under fire conditions.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Accidental Release Measures

Ventilate area, especially low or enclosed places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) if large spill or leak occurs.

HANDLING AND STORAGE

Handling (Personnel)

Use with sufficient ventilation to keep employee exposure below recommended limits. HFC-134a should not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. See Fire and Explosion Data section. Contact with chlorine or other strong oxidizing agents should also be avoided.

Storage

Clean, dry area. Do not heat above 52 deg C (125 deg F).

(Continued)

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low or enclosed places.

Personal Protective Equipment

Impervious gloves and chemical splash goggles should be used when handling liquid. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines

Exposure Limits

"SUVA" COLD-MP

PEL (OSHA)	None Established
TLV (ACGIH)	None Established
AEL * (Du Pont)	1000 ppm, 8 & 12 Hr. TWA
WEEL (AIHA)	1000 ppm, 8 Hr. TWA

* AEL is Du Pont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	-26.5 C (-15.7 F) @ 736 mm Hg
Vapor Pressure	96 psia at 25 deg C (77 deg F)
Vapor Density	3.60 (Air = 1.0) at 25 deg C (77 deg F)
% Volatiles	100 WT%
Solubility in Water	0.15 WT% @ 25 C (77 F) and 14.7 psia
Odor	Slight ethereal
Form	Liquefied gas
Color	Colorless
Density	1.21 g/cc at 25 deg C (77 deg F) - Liquid

STABILITY AND REACTIVITY

Chemical Stability

Material is stable. However, avoid open flames and high temperatures.

Incompatibility with Other Materials

Incompatible with alkali or alkaline earth metals- powdered Al, Zn, Be, etc.

Decomposition

Decomposition products are hazardous. This material can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid and possibly carbonyl fluoride.

Polymerization

Polymerization will not occur.

(Continued)

TOXICOLOGICAL INFORMATION

Animal Data

Inhalation 4-hour ALC: 567,000 ppm in rats

A 5 or 10 second spray of vapor produced very slight eye irritation and a 24-hour occlusive application produced slight skin irritation in rabbits. The compound is not a skin sensitizer in animals. No toxic effects were seen in animals from exposures by inhalation to concentrations up to 81,000 ppm. Lethargy and rapid respiration were observed at a vapor concentration of 305,000 ppm and pulmonary congestion, edema, and central nervous system effects occurred at a vapor concentration of 750,000 ppm. Cardiac sensitization occurred in dogs at 75,000 ppm from the action of exogenous epinephrine. No effects in animals occurred from repeated inhalation exposures to 99,000 ppm for two weeks or to 50,000 ppm for three months. Repeated exposures to higher concentrations caused transient tremors, incoordination and some organ weight changes. Long-term exposure produced increased testes weights and increased urinary fluoride levels. No adverse effects were observed in male and female rats fed 300 mg/kg/day of HFC-134a for 52 weeks. Animal testing indicates that this compound does not have carcinogenic or mutagenic effects. Inhalation of 50,000 ppm for two years caused an increase in benign testicular tumors in male rats. No effects were observed at lower concentrations. The tumors were late-occurring and were judged not to be life-threatening. Embryotoxic activity has been observed in some animal tests but only at maternally toxic dose levels.

DISPOSAL CONSIDERATIONS

Waste Disposal

Contaminated HFC-134a can be recovered by distillation or removed to a permitted waste disposal facility. Comply with Federal, State, and local regulations.

TRANSPORTATION INFORMATION

Shipping Information

Shipping Containers

Tank Cars.
Tank Trucks.

DOT/IMO

Proper Shipping Name

Hazard Class

UN No.

DOT/IMO Label

LIQUIFIED GAS, N.O.S. (TETRAFLUOROETHANE)

2.2

1956

NONFLAMMABLE GAS

Cylinders

Ton Tanks

(Continued)

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status Reported/Included.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : Yes
Fire : No
Reactivity : No
Pressure : Yes

LISTS:

SARA Extremely Hazardous Substance -No
CERCLA Hazardous Substance -No
SARA Toxic Chemicals -No

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating
Health 1
Flammability 0
Reactivity 1

Personal Protection rating to be supplied by user depending on use conditions.

Additional Information

CAUTION:

DO NOT USE IN MEDICAL APPLICATIONS INVOLVING PERMANENT IMPLANTATION IN THE HUMAN BODY.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS DuPont Chemicals
Address Engineering & Product Safety
 P. O. Box 80709, Chestnut Run
 Wilmington, DE 19880-0709

Indicates updated section.

End of MSDS