Report SGC 008

# CATALOGUE OF GAS TECHNOLOGY RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS IN SWEDEN

Issue No. 3

July 1991

# SGC

Report SGC 008

# CATALOGUE OF GAS TECHNOLOGY RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS IN SWEDEN

Issue No. 3

July 1991

## **Table of Contents**

		Page
For	reword	1
Cla and Tec	ssification by area of Research, Development Demonstration (RD&D) within Energy Gas chnology	2
Ab	breviations	3
Info pro	ormation on RD&D projects (completed, in gress and planned)	
1	General research and development	1.1
2	Exploration, recovery and production	2.1
3	Transmission, distribution, storage	3.1
4	Industrial applications	4.1
5	Space heating and related subjects	5.1
6	Gas based cogeneration	6.1
7	Other uses of gas	7.1
8	Measurement technologies	8.1
9	Additional areas of interest	9.1
Ade	dresses App	oendix

#### Foreword

The present catalogue is the third compilation of RD&D (Research, Development and Demonstration) projects in gas research in Sweden. For the present, only natural gas and LPG-related projects are included. Additional information regarding, for example, biogas, coal gas and hydrogen gas, may, however, be available in time. The catalogue is updated every year.

The concept RD&D has been given a broad interpretation in the catalogue. Because gas technology is relatively new in Sweden, it seems justified to include even those projects that are not, strictly speaking, RD&D projects, if they contribute to the general advancement of knowledge in the area of gas technology.

The projects have been classified into nine areas in accordance with the list on page 2. Each area encompasses projects that have been completed, are in progress, or are in the planning stage. Projects completed before 1988 are not included here, but can be found in the previous issues of the project catalogue. For certain of the planned projects, no indication is given under the headings, "ordered by/financed by" or under "carried out by". Such projects are, for all practical purposes, to be considered project ideas which can be taken up and developed by any interested party.

Information about the projects can be obtained from the persons listed as project leaders, contact persons, etc. At the end of the catalogue, you will find the addresses of the companies where the contact persons may be reached. Reports from Vattenfall (Swedish State Power Board) can also be obtained from their Älvkarleby laboratory. In general all reports are in Swedish.

Swedish companies and organizations having or planning projects not included in this catalogue are encouraged to send in project data to The Swedish Centre for Gas Technology, Ltd (SGC). The projects will thereby be published in the next issue of the catalogue.

SGC is a joint organization of the Swedish Gas Association (Svenska Gasföreningen), Swedish Gas, Ltd. (SwedeGas, AB), Southern Gas, Ltd (Sydgas, AB), Swedish State Power Board (Vattenfall), Southern Sweden Power Supply Ltd, (Sydkraft AB), Malmoe's Energy Works (Malmö Energi, AB) and Gothenburg's Energy Works (Göteborg Energi AB).

#### **Classification by area of Research-Developmentand-Demonstration within ENERGY GAS TECHNOLOGY**

- 1 General research and development, e.g. combustion, emissions, gas analysis, gas quality, interchangeability
- 2 Exploration, recovery and production
- 3 Transmission, distribution, storage
- 4 Industrial applications
- 5 Space heating and related areas
- 6 Gas based cogeneration
- 7 Other uses of gas, e.g, CO<sub>2</sub>-in plant cultivation, operation of heat pumps, operation of vehicles, chemical raw materials
- 8 Measurement technologies
- 9 Additional areas of interest, e.g. security, standards, manuals, load management, environmental impact

(The term gas includes as well LPG and LNG.)

# **ABBREVIATIONS USED IN THIS CATALOGUE**

Organizations	BFR	Swedish Co	uncil for Building Research, Stockholm (Byggforskningsrådet)
U	DTI	Department (Driftteknisk	of Control and Maintenance, Lund Institute of Technology ka Institutionen vid LTH, Malmö)
	EGIL	The Gas Res (Energigasir	search Institute, Lund Institute of Technology, Lund Institutet vid LTH, Lund)
	FTC	Combustion (Förbrännin	n Centre, Lund Institute of Technology, Lund Igstekniskt Centrum, LTH, Lund)
	GC	The Gas Cer activities we	ntre (GasCentrum). Ceased to exist in the Spring of 1990. Its ere transferred to the Swedish Centre for Gas Technology (SGC)
	GE	Gothenburg	's Energy Works (Göteborg Energi AB)
	GU	The Univers	sity of Gothenburg (Göteborgs Universitet)
	KTH	Royal Institu	ute of Technology (Kungl Tekniska Högskolan, Stockholm)
	LTH	Lund Institu	ite of Technology (Lunds Tekniska Högskola)
	LU	Lund Unive	rsity (Lunds Universitet)
	NGC	Nordic Gas	Technology Center (Nordisk Gasteknisk Center)
	SA	The Swedish (Statens And	h Plant Inspectorate, Stockholm läggningsprovningar)
	SAMKO	The Souther (Sydgasföre	rn Gas Company's Joint Committee tagens samarbetskommitté)
	SEU	Swedish En	ergy Development, Ltd (Svensk Energiutveckling AB)
	SG	Southern Ga	as, Ltd (Sydgas AB)
	SGC	Swedish Ce	entre for Gas Technology (Svenskt Gastekniskt Center AB)
	SGF	Swedish Ga	s Association (Svenska Gasföreningen)
	SK	Southern Sv	veden Power Supply (Sydkraft AB)
	SNV	National En	vironmental Protection Agency (Statens Naturvårdsverk)
	SP	National Tea	sting Institute (Statens Provningsanstalt)
	SSF	Sydkraft's R	Research Foundation (Sydkrafts Forskningsstiftelse)
	STATT	Swedish Tec	chnical Attaché system (Sveriges Tekniska Attachéer)
	STEV	The Nationa	I Energy Administration (Statens Energiverk)
	STU	The Nationa (Styrelsen fö	l Board for Technical Development ör Teknisk Utveckling)
	SV	Swedish Sta	te Power Board (Vattenfall, Stockholm)
	SVSS	A joint orga Sydgas and were transfe	nization of SwedeGas, The Swedish State Power Board, Sydkraft (Ceased to exist in the Spring of 1990. Its activities erred to the Swedish Centre for Gas Technology (SGC)
	SWG	Swedish Ga	s, Ltd (SwedeGas AB)
	TFB	Transport Re	esearch Board (Transportforskningsberedningen)
	TG	Terminal Ga	as, Ltd (Terminalgas AB)
	TVE	Theorell and	d VBB, Energy Consultants (Theorell och VBB Energikonsulter)
	VF	Thermal Eng	gineering Research Institute (Värmeforsk, Stockholm)
	ÅF	The Swedish (ÅngpanneF	h Steam Users Association Consultants Föreningen, ÅF Energikonsult)
Schedule	Compl Compl 198 Compl Fet Curr Curr 1988	39 7 5 1989 7 1990 7	The project has been completed The project was completed in 1989 The project was completed in February of 1989 The project is currently in progress The project began in 1988, estimated completion: during the course of 1990
	Plan 1990	]	The project is planned to be carried out in 1990

#### July 1991

#### 1. GENERAL RESEARCH AND DEVELOPMENT

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	REBURNING WITH NATURAL GAS IN LARGER MUNICIPAL REFUSE INCINERA- TION PLANTS Investigation of the prospects for using reburning plants in Sweden and collection of information from international sources.	SwedeGas	ÅF	Compl 1989	Thomas Carlqvist, SWG Lars Wrangensten, ÅF
STU 89-1762	SOUND REDUCTION IN PULSONEX'S RIPPLE BOILER FOR GAS/OIL Analysis of how sound propagates in the boiler.	STU	Teknisk akustik, CTH and Pulsonex	Compl 1989	Jan Nilsson, Pulsonex
STU 88-4139	PULSATING COMBUSTION WITH LOW FREQUENCY SOUND Preliminary stage.	STU	Teknisk akustik, CTH	Compl Aug 1990	Elizabeth Lindqvist, STU
VF G8-806	LIMITATION OF NO <sub>x</sub> BY WATER INJECTION. PHASE 1 – PRELIMINARY STUDY A study of the feasibility of limiting NO <sub>x</sub> forma- tion in boilers by using water injection, including a proposal for a main study comprising practical experiments.	Värmeforsk	TVE	Compl Dec 1990	Göran Fermbäck, TVE VF's report is expected April 1991.
	COMBUSTION OF NATURAL GAS WITH OXYGEN A study of the literature in order to elucidate the effect on $NO_x$ -formation as well as on costs.	Sydgas/ /GasCentrum	Sydkraft, avd TBE	Compl 1990	Lars Nilsson, SG Åsa Marbe, SK Report is expected spring 1991.
VF G8-819	CATALYTIC BURNERS FOR NATURAL GAS Development of a catalytic burner for natural gas Part 1. Obtaining model-scale burners.	Värmeforsk	Katator HB	Compl Jan 1991	Jan Brandin, Katator HB VF-report is expected April 1991
VF G8-706	EMISSIONS DURING TURBULENT COM- BUSTION The project, designed to provide new knowledge of the area, includes evaluation of various calculation techniques for the prediction of emissions during turbulent combustion.	Värmeforsk	LTH, Värme- och Kraft- teknik	Curr 1986- -1991	Tord Torisson, Värme- och Kraft- teknik, LTH
STEV 276 82	COMBUSTION TECHNOLOGY Basic experimental studies of chemical kinetics.	STEV	LTH Fysik	Curr 1986- -1993	Marcus Aldén Fysik, LTH
STEV 276 150	CATALYTIC DENITRIFICATION Catalytic reduction of NO <sub>X</sub> .	STEV	LTH	Curr 1987- -1992	Ingemar Odenbrand, LTH

Sheet 1.1

#### 1. GENERAL RESEARCH AND DEVELOPMENT

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	REBURNING WITH NATURAL GAS IN LARGER MUNICIPAL REFUSE INCINERA- TION PLANTS Investigation of the prospects for using reburning plants in Sweden and collection of information from international sources.	SwedeGas	ÅF	Compl 1989	Thomas Carlqvist, SWG Lars Wrangensten, ÅF
STU 89-1762	SOUND REDUCTION IN PULSONEX'S RIPPLE BOILER FOR GAS/OIL Analysis of how sound propagates in the boiler.	STU	Teknisk akustik, CTH and Pulsonex	Compl 1989	Jan Nilsson, Pulsonex
STU 88-4139	PULSATING COMBUSTION WITH LOW FREQUENCY SOUND Preliminary stage.	STU	Teknisk akustik, CTH	Compl Aug 1990	Elizabeth Lindqvist, STU
VF G8-806	LIMITATION OF NO <sub>x</sub> BY WATER INJECTION. PHASE 1 – PRELIMINARY STUDY A study of the feasibility of limiting NO <sub>x</sub> forma- tion in boilers by using water injection, including a proposal for a main study comprising practical experiments.	Värmeforsk	TVE	Compl Dec 1990	Göran Fermbäck, TVE VF's report is expected April 1991.
	COMBUSTION OF NATURAL GAS WITH OXYGEN A study of the literature in order to elucidate the effect on $NO_x$ -formation as well as on costs.	Sydgas/ /GasCentrum	Sydkraft, TBE section	Compl 1990	Lars Nilsson, SG Åsa Marbe, SK Report is expected spring 1991.
VF G8-819	CATALYTIC BURNERS FOR NATURAL GAS Development of a catalytic burner for natural gas Part 1. Obtaining model-scale burners.	Värmeforsk	Katator HB	Compi Jan 1991	Jan Brandin, Katator HB VF-report is expected April 1991
VF G8-706	EMISSIONS DURING TURBULENT COM- BUSTION The project, designed to provide new knowledge of the area, includes evaluation of various calculation techniques for the prediction of emissions during turbulent combustion.	Värmeforsk	LTH, Värme- och Kraft- teknik	Curr 1986- -1991	Tord Torisson, Värme- och Kraft- teknik, LTH
STEV 276 82	COMBUSTION TECHNOLOGY Basic experimental studies of chemical kinetics.	STEV	LTH Fysik	Curr 1986- -1993	Marcus Aldén Fysik, LTH
STEV 276 150	CATALYTIC DENITRIFICATION Catalytic reduction of NO <sub>X</sub> .	STEV	LTH	Curr 1987- -1992	Ingemar Odenbrand, LTH

July 1991 Sheet 1.1

and the state of the second

## July 1991

#### GENERAL RESEARCH AND DEVELOPMENT 1.

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SV 98453 14001	VARIATIONS IN GAS QUALITY Light is shed on the following issues: What variations can be expected? How well do various apparatuses presently available cope with these variations? Is it possible to recommend limit values and test methods?	Vattenfall	Vattenfall, BES section	Curr 1989- -1991	Kjell Steen, BEP, Vattenfall
STEV 656 083	VARIATIONS IN GAS TEMPERATURE AND ITS EFFECT ON OPERATION AND MAINTENANCE An investigation of how temperatures of as low as -30 °C have on burner functioning as well as on the reliability of safety and control equipment.	STEV	DTI	Curr 1988- -1991	Sören Dahlin, DTI
STEV 276 219	COMBUSTION KINETICS Basic studies of chemical kinetics.	STEV	LTH, Fysik	Curr 1988- -1993	Marcus Aldén, Fysikum LTH
STEV 656 100	SETTING UP A GAS RESEARCH LABORA- TORY AT THE LUND INSTITUTE OF TECHNOLOGY	STEV	Värme- och Kraft, LTH	Curr 1988- -1991	Lennart Thörnqvist, LTH
STU 89-1039 90-928 90-180	NEW SYSTEMS FOR AIR/FUEL-RATIO REGULATION A study of control systems, inter alia control systems with pneumatic (as opposed to mechanical) coupling between air and gas. Post graduate research	STU	DTI	Curr 1989- -1992	Sören Dahlin, DTI
SV 93741	NATURAL GAS COMBUSTION, A STUDY OF MODELS Development of various methods for calculation of combustion processes with applications for combustion chambers and steam boilers, that is, for production of electricity and heat.	Vattenfall/ /SV, SK, ABB Stal	Värme och Kraft, LTH	Curr 1989- -1991	Tord Torisson, LTH
STU 89-2313	THE SETTING UP OF A GAS MOTOR RESEARCH LABORATORY AT THE LUND INSTITUTE OF TECHNOLOGY	STU and others	Värme och Kraft, LTH	Curr 1989- -1992	Gunnar Lundhoim, Värme och Kraft, LTH
STU 88-4140 VF G0-107	PULSATING COMBUSTION Theoretical aspects of pulsating combustion. Development of simulation models.	STU (possibly Värmeforsk)	LTH Mekanik, Värme o Kraft	Curr 1989- -1993	Ebbe Lundgren, LTH, Mikael Näslund, LTH
	DIRECT USE OF GAS CONDENSATE Transmission techniques, quality variations, inter alia, are studied.	Vattenfall	Vattenfall	Curr 1990- -1991	Kari Lähdemäki, Vattenfall Energi- system AB

#### Sheet 1.3

#### 1. GENERAL RESEARCH AND DEVELOPMENT

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
VF G1-103	CATALYTIC BURNER NATURAL GAS. A CONTIUNATION OF THE PROJECT. STAGE 1 Objective: To obtain a deeper knowledge of a burner model that was developed earlier and to use that knowledge as a basis for the development of a prototype burner. Description: In an earlier project (G8-819) a model for a catalytic burner was developed. In the present project will be investigated - other materials, especially ceramic fibers - fuel supply in detail - variations of activity in the beds - alternative material in the thermal buffer - LNG and hydrogen (previously only natural gas was studied)	Värmeforsk	Katator, Lund	Curr 1991- -1992	Lars H Andersson, Katator HB
STEV 276 262	FORMATION AND REDUCTION OF NITROGEN COMPOUNDS Investigation of formation and reduction of nitrogen compounds in laminar flames and flow vectors	STEV	СТН	Curr 1991- -1993	Jim Olsson, CTH
	CATALYTIC COMBUSTION Investigation of the conditions for initiating further research and development efforts in Sweden.	STEV	Technology Institute	Plan 1991	Stefan Montin, STEV Bengt Kasemo, CTH Sven Järås, KTH
	RESEARCH BOILER AT KTH Installation of 14 MW research boiler at KTH is planned. It will burn, inter alia, natural gas.	STEV and others	КТН	Pian 1991	Sten Frostäng, STEV Gunnar Svedberg, KTH

#### Sheet 2.1

#### 2. EXPLORATION, RECOVERY, PRODUCTION

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SV 98456 24000	BITUMEN – AN INVESTIGATION Chemical analyses of hydrocarbons with regard to isotopes, biomarkers and trace elements to be interpreted as regards whether their origin is organic or inorganic, and also as regards in what environment higher hydrocarbons are formed.	Vattenfall	Stockholm's University	Compl Jan 1989	Lars Brolin, BEL, Vattenfall Bill Wallin, Sthlm's University
SV 98460	DEEP GAS PROJECT A geological and scientific evaluation.	Vattenfall	Vattenfall	Curr 1986- -1991	Hans Gransell, Vattenfall A number of sub- reports are available.

#### July 1991

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	CORROSION PROTECTION a) The effect of the Earth's magnetic field on the measurement of cathodic protection potential	Sydkraft/SSF	Korrosions- institutet	Compl 1989	Björn Hedén, Sydkraft
	b) Investigation of the causes of loss of cathodic adherence				
	<ul> <li>c) Compilation of accepted standards for protective lining of gas lines.</li> </ul>				
	EVALUATING THE QUALITY OF BUTT WELDING PE-PIPES USING THE THIN SECTION METHOD The results show that checking by means of the thin section method is a reliable method for evaluation of welds.	Sydgas/SSF	TUMAB, Landskrona	Compl June 1989	Rolf Mårtensson, Sydgas GasCentrum report GC 89.04
	GLASS-FIBER REINFORCED PLASTIC FOR NATURAL GAS DISTRIBUTION	Vattenfall	Vattenfall	Compl 1989	B Svensson SV report 89/2
	STANDARDIZATION OF M/R-STATIONS	Sydgas	Sydkraft	Compl 1989	Björn Hedén, TBE Sydkraft SK report is available
STEV 656 076	STUDIES OF THE FEASIBILITY OF LNG- STORAGE	STEV	СТН -	Сит 1989	Ulf Lindblom, CTH
SV 98453 10002	LPG/AIR-BLENDING EQUIPMENT – LINKING TO M/R-STATIONS This work will, inter alia, establish a technical basis for the design of storage facilities, system alternatives and performance requirements for blending equipment as well as for system configuration in general.	Vattenfall	Vattenfall, BES section	Comp1 Dec 1989	Kjell Steen, BES, SV
SV 98452 02030	DETAILED PLANNING OF NATURAL GAS SYSTEMS WITH PC-CAD Information transfer between different types of CAD-systems, education, evaluation and test- planning.	Vattenfall	Vattenfall	Compl 1990	Lars Winter, BEP, SV
SVSS 89.06 SK 90.24	NON DESTRUCTIVE TEST OF PE-JOINTS. A PRELIMINARY STUDY Literature search and compilation of data on international equipment and experience. Evaluation of reliability.	SG/ /SK, SV	SA, Stockholm	Compl 1990	Rolf Mårtensson, SG

Sheet 3.1

July 1991

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

t				<del></del>	t <del></del>	
	Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	SVSS 89.07	THE EFFECT OF LPG CONDENSATE (ETC.) ON PE-LINES Materials tests, analyses and welding tests on PE- lines that are contaminated with ThT, mercaptan, LPG condensate and compressor oil in order to determine their influence on butt welding properties	Lunds Energiverk/ /GC, Vattenfall	TUMAB, Landskrona	Comp1 1990	Rolf Jönsson, Lunds Energiverk Fleming Varmedal, TUMAB Report in springtime of 1991
	VF G8-911	VACUUM INSULATION FOR CONDENSED NATURAL GAS A study of the conditions required for the introduction of components (pipe lines, etc.) composed of an outer and inner casing with infusorial silicon under vacuum as insulation.	Värmeforsk n	Studsvik	Compl Aug 1990	Stefan Swebilius, Studsvik VF report No. 374
		ANALYSIS OF RISKS IN LPG STATIONS The purpose is to determine the risk for personal injury as well as damage of material. The analysis includes determination of the rated cases of injury or damage as well as probability-and-consequence analysis of the dominant sequence of events.	Sydkraft, Neste	Sydkraft, TVQ section	Compl 1990	Sigvard Trönell, SK Internal report is available.
	STEV 656 108 SK 90.31	BRITTLE FRACTURE IN GAS PIPES Presentation of criteria obtained regarding dimensioning and related information.	STEV/ /STEV, SK	KTH	Compl 1990	Rolf Sandström, KTH Anders Molin, SK
	SV 93753	COMPONENTS FABRICATED IN COMPO- SITE MATERIALS Preliminary study of components in composite material for distribution networks as well as demonstration of pressure vessels for a natural gas bus in Malmö.	SwedeGas, Vattenfall, ABB Plast, Industridep	ABB Plast, Vattenfall, BEP section	Compi 1990	Rolf Mattsson, Sture Öqvist, ABB Plast Björn Svensson, SWG
	SK 90.14	REPAIR METHODS FOR HIGH PRESSURE LINES Methods for making welding connections under conditions of full operation.	Sydgas/ /Sydkraft	Sydgas	Comp1 1990	Göran Tillberg, SG
	SGC 90.26	SYSTEMS OPTIMIZATION WITH REGARD TO THE LINE PRESSURE <u>Objective</u> : To answer the question: which are the criteria that govern the choice of pressure level (0,4 or 16 bar) in a distribution system for natural g <u>Description</u> : The effects of the following parameters will be studied: Existing rules and regulations, system design, power level, the costs for the facility, operation and maintenance, future	Sydgas as.	TUMAB	Compl 1991	Rolf Mårtensson, SG Report SGC 001
ļ		have been by the base of the b				

July 1991

Sheet 3.3

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

Internal	PROJECT NAME	Ordered by/	Carried	Time	Project leader
project designa- tion	Project description	/Financed by	out by	Schedule	Contact person Report designation Comments, etc.
SV 98460 05001 SK 90.02	GAS STORAGE DEVELOPMENT IN SCANDINAVIA (GUN) Studies of "air pillows" in Norwegian hydroeletric power stations as well as application of the technique with water-tight gas storage facilities in underground rock. A pilot project using one or several of the "air pillows". The GUN-programme consists of several sub-projects.	SINTEF (Norway), Statkraft, Neste, SV, SWG, SK	SINTEF, Vattenfall (BEL)	Curr 1988- until further notice	Anders Bodén, SV Börge Knutsson, SK
SV 98462 10000 SK 90.03	PLASTIC LINERS IN NATURAL GAS STORAGE FACILITIES The purpose is to develop a plastic laminate that can constitute a technically and economically competitive alternative insulating material. Long- term testing is included.	Vattenfall, Sydkraft Studsvik	Vattenfall (BEL), Studsvik	Curr 1988- -1991	Anders Bodén, BEL, SV (The project is a part of the Grängesberg project.)
SV	COOLED NATURAL GAS STORAGE FACILITIES The project consists in developing a functioning and economical method for storing cooled natural gas so as to thereby increase storage capacity.	Vattenfall/ /Diff Nordic financers s	Vattenfall,	Curr 1988- -1991	Anders Bodén, BEL, SV Joint Nordic project.
SV 93751	PLASTIC PIPES FOR GAS DISTRIBUTION Investigation of material properties in PE-pipes as well as of their commercial application. Contents: Study of the literature, properties, methods for fast quality control, environmental impact.	Vattenfall, Studsvik, Neste Polyeten AB	Studsvik	Curr 1988- -1991	PL: Tomas Tränkner Studsvik Kari Lähdemäki, BES, Vattenfall
STEV 656 087	<ul> <li>STORAGE METHODS FOR NATURAL GAS/LPG (A GENERAL PROGRAMME)</li> <li>Area of research: <ul> <li>Models for calculation of rock mechanics</li> <li>Determination of parameters for underground material</li> <li>Interaction of storage products/lining/rock</li> </ul> </li> </ul>	STEV	СТН	Curr 1988- -1992	Project leader Ulf Lindblom, CTH Total cost 3 MSEK
	The project is being carried out in close connection with the operations at the pilot facility at Röda Ster	ļ. ļ.			
STEV 656 109	BASIC RESEARCH INTO THE USE OF PLASTIC PIPING FOR GAS DISTRIBUTION Clarification of the relationschip beween molecular structure, mechanisms causing fracturing and environmental impact.	STEV, STU	KTH, Studsvik	Curr 1989- -1991	Ulf Gedde, Polymerteknologi, KTH
STEV 654 004	CONSTRUCTION OF UNDERGROUND ROCK CAVITY LABORATORY, "RÖDA STEN" Chalmers is building a permanent test facility for gas storage research in Röda Sten, Gothenburg, in cooperation with Göteborg Energi and NCC.	STEV	СТН	Curr 1989- -1991	Ulf Lindblom, CTH

4.

July 1991

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

• · · · · · · · · · · · · · · · · ·		-	• <u>-                                    </u>		<u> </u>
Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SV 93769	OPTIMAL PERFORMANCE OF M/R- STATIONS Feasibility study and recommendations regarding arrangements for recovering electrical energy from expanding natural gas during pressure reduction in M/R stations.	Vattenfall	Vattenfall	Сигт 1990- -1991	Rolf Mattson, BEP, SV Only internal SV report.
SK 90.19	REFERENCES FOR ULTRASONIC TESTING Swedish authorities require today that ultrasonic equipment for checking of pipe material be calibrated for errors of plus or minus 5 % of the thickness of the material (N5-notch). Internationally 10 % of thickness (N10) is used. The study will establish requirements for calibration tolerance.	Sydgas	Sydkraft	Curr 1990- -1991	Lars Clemensson, SK
SK 90.23	REQUIREMENTS FOR MATERIAL USED FOR PACKING GAS LINES Presentation of requirements obtained for packing material used both for PE and steel pipes.	Sydgas	Sydkraft, TBG section	Curr 1990 -1991	Lars Clemensson, TBG, Sydkraft
SK 90.20	COATING OF STEEL PIPES IN ROCKY TERRAIN Investigation of suitable form and appropriate material for the coating of steel pipes which are located in rocky terrain.	Sydgas	Sydkraft	Curr 1990- -1991	Lars Clemensson, SK Report from stage 1 is available.
SK 90.10	CORROSION PROBLEMS IN DISTRIBUTION LINES Included are alternating current corrosion, measure- ment methods, cathodic protection, line coating, valve arrangements and corrosion in protection pipe	Sydgas/ /Sydkraft s.	Sydkraft, Korrosions- institutet	Curr 1990- -1992	Göran Tillberg, SG
SK 90.11	HIGH PRESSURE PIPE LINE SYSTEMS Various studies regarding choice of material, ventilation-systems design, welding methods and turboexpanders.	Sydgas/ /Sydkraft	Sydkraft, TB section	Curr 1990- -1991	Göran Tillberg, SG
SGC 90.25	NEW METHOD FOR LAYING PE-PIPES <u>Objective</u> : Presentation of a proposal for a research programme in the area of new methods for laying pipes.	SGC	Ove Ribber- ström Pro- jektering	Curr 1990- -1991	Lars Clemensson, SK
	<u>Description</u> : The projects includes an inventory of different pipe-laying methods with the emphasis on non-conventional methods such as ploughing, horizontal pressing, and drilling. The inventory taken will result in a proposal for a demonstration of new pipe-laying methods.				

Sheet 3.4

July 1991

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SV 98466 STEV 654 013	PILOT FACILITY FOR NATURAL GAS STORAGE IN GRÄNGESBERG (FIG) Construction, testing and evaluation of three storage concepts: thin plate, thick plate and plastic lined storage facilities.	Vattenfall/ /Sydgas, Sydkraft, STEV, Swedegas Skanska and others	BPA/ /Skanska	Curr 1991- -1992	Christer Kallmén, SG Total cost 4,5 MSEK
SGC 90.60	TESTING OF PE-PIPES FOR LPG DISTRIBU- TION <u>Objective</u> : To investigate the resistance of PE- pipes to long-term exposure to LPG condensate.	SGC	Vattenfall, BES	Сшт 1991	Bo Berggren, SV Jonas Forsman, SV
	<u>Description</u> : PE-pipes that were used for five years for distribution of LPG in Kalix will be dug up and transported to Studsvik for tests and analyses. Tests will also be carried out on unexposed pipes.				
SGC 91.01	PLOUGHING OF GAS PIPES A study of the relative advantages and disadvan- tages of ploughing pipes as compared to conven- tional laying methods. A demonstration project.	SGC	Malmö Energi and Statens Geo- logiska Institut (SGI)	Curr 1991	Håkan Haglund, ME Alf Lindmark, SGI
SGC 91.04	BUTT WELDING AND ELECTROMUFF WELD ASPECTS OF COSTS Light is shed on the factors that influence costs for both welding methods.	SGC	TUMAB	Curr 1991	Rolf Mårtensson, SG
SGC 91.05	FIELD SORTING OF FILLING MASS WHEN LAYING PE-PIPES WITH A LAYING BOX Demonstration project in which a laying box and sorting of excavated material are employed so as to later use the excavated material as filler in the place of gravel.	SGC	Sydbränsle AB	Curr 1991	Rolf Mårtensson, SG Göran Lustig, Syd- bränsle
	INCREASING PRESSURE IN PE-SYSTEMS Feasibility study regarding working with pressures higher than those presently accepted for PE-lines.	Sydgas	Svenska Gas- föreningen	Plan	Rolf Mårtensson, SG A study from British Gas is awaited.
SK 90.35	MODUL-BASED LPG STATIONS Standardization and simplification in the design of LPG stations aims at adapting the stations to new areas of use for LPG.	Terminalgas/ /Sydkraft	Sydkraft	Pian 1991	Mikko Ronkainen, TG Lennart Andersson, TBE section, SK
SK 90.08	STORAGE OF COOLED NATURAL GAS IN VAPOUR PHASE	Sydgas/ /Sydkraft	Sydkraft, CTH	Plan 1991	Christer Kallmén, SG
SGC 91.06	LEAK DETECTION METHODS FOR GAS PIPE A survey of various existing methods for detecting leaks as well as a general evaluation of such method	S SGC	Sydkraft, TBE section	Plan 1991	Åsa Marbe, SK

July 1991

Sheet 3.6

#### 3. TRANSMISSION, DISTRIBUTION, STORAGE

+	i	<u> </u>		+ <u></u>	
Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SK 90.06	CONVERSION OF EXISTING UNDER- GROUND ROCK RESERVOIRS TO LPG STORAGE FACILITIES Storage of LPG through conversion of existing underground reservoirs for oil storage.	Sydgas, Terminalgas	Sydkraft	Plan 1991 -1992	Mikko Ronkainen, Terminalgas Christer Kallmén, SG
SGC 90.22	LARGE DIAMETER GAS LINES OF PE Technical and economic study of the feasibility of using PE-lines with diameters greater than 225 mm.	Sydgas	Sydkraft, TBG section	Pian 1991	Lars Clemensson, Sydkraft
SK 90.07	STORAGE OF LPG IN SMALLER UNDER- GROUND ROCK RESERVOIRS. PILOT FACILITY	Terminalgas/ /SycIkraft	Sydkraft	Plan 1991 -1992	Mikko Ronkainen, Terminalgas
SK 90.01	MEASUREMENT OF FLOW BALANCE IN NATURAL GAS STORAGE FACILITIES, INCLUDING CHECKING FOR GAS LEAKAGE Storage of natural gas in underground rock reservoir is studied using a number of alternative storage concepts. Measurement methods and measurement accuracy for filling and emptying of stores is of crucial importance in this context.	Sydkraft	Sydkraft	Plan 1991- -1993	Björn Hedén, Sydkraft
SK 90.12	COMPRESSION STATIONS, SITING CRITERIA Location criteria should include: – line compressors for continuous operation – line-packing-compressors for night gas – high pressure compressors for cogeneration plants	Sydgas/ /Sydkraft	Sydkraft, TB section	Plan 1991	Göran Tillberg, SG
SK 90.34	DISTRIBUTING LPG IN THE LIQUID PHASE Advantages and limitations of the distribution of LPG in the liquid phase, e.g. material and length of lines.	Terminalgas/ /Sydkraft	Sydkraft	Plan 1991- -1992	Mikko Ronkainen, TG (It may be an IGU project.)
SK 90.33	PREPAREDNESS REQUIREMENTS FOR LPG/NATURGAS	Terminalgas/ TG, SG	Sydgas, Terminalgas	Plan 1991- -1992	Mikko Ronkainen, TG
SK 90.04	DEMONSTRATION FACILITY FOR NATURAL GAS Demonstration of natural gas storage in lined underground rock reservoirs.	Sydgas/ /Sydkraft	Sydkraft	Plan 1991- -1993	Christer Kallmén, SG
SK 90.36	LPG FACILITIES, STUDIES Studies of sprinkler performance, packing material and volatilization techniques.	Terminalgas/ /Sydkraft	Sydkraft, TBE section	Plan 1991- -1993	Mikko Ronkainen, TG

July 1991

#### Sheet 4.1

### 4. INDUSTRIAL APPLICATIONS

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	CONVERSION OF HIGH TEMPERATURE FURNACES TO NATURAL GAS Data as well as calculational support and computer programmes were used to evaluate changes in efficiency, capacity and $NO_x$ buildup with the con- version of high temperature furnaces to natural gas.	SwedeGas/ /SwedeGas, STU	Inst för Värme- och Ugnsteknik, KTH, Sthlm	Compl Jan 1989	Mats Johansson, AGA Rolf Collin, KTH SwedeGas report is available.
	PROSPECTS FOR CONVERTING A CONVEN- TIONAL DRYER FROM STEAM TO DIRECT USE OF NATURAL GAS EXHAUST Conversion of an Exergy steam dryer was studied. Its size corresponds to that of the proposed drying capacity for Ryaverket's sludge. The study indicates several advantages over steam drying.	SwedeGas	Svensk Energiteknik AB, Ekotek- nik AB	Compl Jan 1989	Thomas Carlqvist, NGC SwedeGas report is available.
	REPLACEMENT OF ELECTRICITY WITH NATURAL GAS FOR INDUSTRIAL PROCESSES A survey was conducted of those processes which might prove to be technically, and, in the long run, economically, feasible for conversion to natural gas The iron and steel industries are not included.	SwedeGas	ÅF	Compl Febr 1989	Mats Johansson, AGA Karin Byman, ÅF SwedeGas report is available.
SWG U5.2	DESTRUCTION OF HYDROCARBONS IN INCINERATORS A study of the possibilities of oxidizing combustible pollutants in flue gases by destruction with the aid of natural gas. The report also contains a preliminary basis for the calculation of $NO_X$ -formation.	SwedeGas	Gasunie	Compl March 1989	Ingemar Gunnarsson, SwedeGas SwedeGas report is available under the title "Hydrocarbon Destruction in Incinerators. (In English)
	COMBUSTION OF HAZARDOUS WASTE WITH NATURAL GAS The report contains technical descriptions and conversion costs for change-over to natural gas combustion facilities for hazardous wastes as well as for crematorium ovens.	SwedeGas	ÅF	Compl March 1989	Thomas Carlqvist, NGC SwedeGas report is available.
STU 88-3749	INDUSTRIAL APPLICATIONS OF LNG. A PRELIMINARY STUDY The project will show practical examples of applications of LNG in industry, e.g., the chemical and food industries.	STU	Energipla- nerama AB	Compl March 1989	Tord Holmström Göran Persson, STU
	IR-HEATERS IN THE PACKAGING INDUSTRY (SCA EMBALLAGE AB) A preliminary study to determine the necessary conditions for and the advantages of going over to use of gas-fired IR- radiators.	SwedeGas	VIAK, Gbg	Compl April 1989	Thomas Carlqvist, NGC SwedeGas report is available.
VF B4-642	LPG AND NATURAL GAS FIRING IN FIRE TUBE BOILERS	Värmeforsk	ÅF	Compl April 1989	Sune Andersson, ÅF VF-report No. 332.

#### 4. INDUSTRIAL APPLICATIONS

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	IR-HEATERS IN THE PLASTIC CARPET INDUSTRY (FORBO-FORSHAGA) A preliminary study to establish the conditions and advantages of a change-over to gas-fired IR-radiators in process equipment.	SwedeGas	VIAK, Gbg	Compl April 1989	Thomas Carlqvist, NGC SwedeGas report is available.
SVSS 89.03	NATURAL GAS IN CUTTING Introduction of natural gas for purposes of cutting, using existing cutting machines. The parameters that are studied are: plate thickness, gas pressure, cutting speed, section surface and gas consumption.	Sydgas/ /SG, SWG	Sydkraft	Compl Dec 1989	Åsa Marbe, SK GasCentrum report GC 89.05
	NATURAL GAS IN THE IRON AND STEEL INDUSTRY The project will show which processes and operations are of interest for conversion from oil or electricity to natural gas.	SwedeGas, Jernkontoret, STU	Jernkontoret	Compl 1989	Mats Johansson, AGA Birgitta Lindblad, Jernkontoret See the Article in Energiteknik No. 1 1989.
	INVENTORY OF THE MARKET FOR IR- DRYING IN THE PAPER INDUSTRY IN SOUTHERN SWEDEN	SwedeGas	Jaako Pöyry	Compl 1989	Thomas Carlqvist, NGC SwedeGas report is available.
	NATURAL GAS IN THE FOUNDRY INDUSTRY The project will show which processes and opera- tions are of interest for conversion to natural gas.	SwedeGas, Sv Gjuteri- föreningen, STU	Sv Gjuteri- föreningen	Compl 1989	Mats Johansson, AGA SwedeGas report is available.
VF G5-515	IR-RADIATORS FOR INDUSTRIAL USE – – MEASUREMENT REPORT Further studies with results from, inter alia, CO and $NO_x$ - measurements. Levels immediately adjacent to the radiator are between 10 and 40 ppm for CO and between 10 and 20 ppm for $NO_x$ .	Värmeforsk	DTI, Malmö	Compl Mars 1990	Michael Johansson, DTI (Internal VF-report)
VF G5-601	RECUPERATIVE AND REGENERATIVE BURNERS IN INDUSTRIAL PROCESSES. EMISSION MEASUREMENT OF RECUPERA- TIVE BURNERS Further study of, inter alia, measurement of $NO_x$ from an existing burner. $NO_x$ contents as a function of the temperature of air preheating is given.	Värmeforsk	DTI, Malmö	Compl March 1990	Sören Dahlin, DTI (Internal VF-report)
STU 89-1266	CONVERSION OF OIL/NATURAL GAS IN PUSHER TYPE FURNACES Study of changes in productivity, energy consump- tion and oxide scale formation during conversion of a furnace at Fundia Bygg AB (formerly Halmstad Jernverk) from oil to natural gas. KTH (Heat and furnace technology) will carry out mathematical modelling.	STU SWG SK	Fundia Bygg, Jernkontoret, KTH m fl	Compl Sept 1990	Birgitta Lindblad, Jernkontoret Rolf Collin, KTH Mats Johansson, AGA Jernkontoret report is available.

### July 1991 Sheet 4.3

#### 4. INDUSTRIAL APPLICATIONS

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SWG U1.3	CONVERSION OF BAKERY OVENS FROM ELECTRICITY TO NATURAL GAS Demonstration project with the conversion of an existing oven.	SwedeGas	El- och Gasteknik AB Dahlén AB	Compl , 1990	Thomas Carlqvist, NGC Lars E Andersson, El- o. Gasteknik AB Report is available.
SGC 90.55	GASEOUS FUELS IN GLASS FURNACES. A PRELIMINARY STUDY Objective: To develop a basis for possible decisions regarding extensive research and development (FUD) efforts concerning natural gas and LGP as fuels for glass furnaces.	NGC m fl	Glasforsk- ningsinsti- tutet,Växjö	Compl 1991	Internal NGC-report.
	<u>Description</u> : The preliminary study includes investig tion of the literature, market analyses, study visits and contacts with British Gas. The study will also result in the presentation of proposals for continued efforts in this area.	;a-			
SSF 308 SGC 88.08	DECENTRALIZED USE OF GAS FOR WARMING OF LIQUIDS The purpose is to carry out a survey of the effects of changeover to decentralized heating with natural gas. To be conducted at Scan Väst and Falkens breweries.	STU, GC SwedeGas, ÅF	ÅF, Malmö	Curr 1988- -1991	Rolf Christensen, ÅF Malmö Lars Nilsson, SG
SWG II	ENERGY FOLLOW-UP AT SCAN VÄST IN VARBERG A follow-up of the conversion to natural gas at Scan Vast in Varberg with reference, inter alia, to the singeing furnace.	SwedeGas	ÅF, Malmö	Curr 1989- -1991	Rolf Christensen, ÅF Malmö
SGC 88.06	CERAMIC FIBER BURNERS Demonstration and evaluation of operational and environmental properties as well as of performance of a ceramic fiber burner at ca 150 kW.	Sydgas/ /SGC	Sydkraft	Curr 1989- -1991	Per Carlsson, SK Lars Nilsson, SG
VF G8-817 STU 88-4726 SGC 88.09	GAS-FIRED IR-RADIATORS FOR DRYING PROCESSES Investigation of the power input and reported radatic power, spectral characteristic and operations and maintenance properties.	VF/VF, STU, SGC n	DTI	Curr 1989- -1991	Sören Dahlin, DTI
VF G8-815	CONVERSION TO NATURAL GAS IN DIFFE- RENT BRANCHES OF THE ENERGY INDUSTR A study of the conversion to natural gas within the food industry. A case study: Arla Dairies in Götene.	Värmeforsk Y	ÅF	Curr 1989- -1991	Project leader: Per Göransson, ÅF
	HEATING OF ZINK BATHS WITH NATURAL GAS IMMERSION PIPES A pilot study: heating and melting of zink with natural gas in the place of electricity.	SwedeGas	El- och Gas- teknik AB	Сит 1989- -1991	

July 1991

in the street best public

#### Sheet 4.4

#### 4. INDUSTRIAL APPLICATIONS

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SGC 90.53	INTEGRATED USE OF NATURAL GAS IN LAUNDRIES <u>Objective</u> : To provide a practical demonstration of an increase in the efficiency of drying drums with the conversion from steam to direct natural gas. Carried out at Tvättman in Helsingborg.	Helsingborg Energi/GC, Tvättman	Sydkraft, TBE section	Curr 1990- -1991	Göran Persson, Helsingborg Energi Roland Brodin, TBE, SK
SGC 88.20	RECUPERATIVE NATURAL GAS BURNERS (Svedala-Arbrå) Objective: Full scale demonstration of recuperative burners in car-type furnaces for the the thermal treatment of castings.	SGC	Sydgas, MEFOS, Sydkraft TVS section	Curr 1990- -1991	Anders Molin, SK
	Description: At Svedela-Arbra eight oil burners are being replaced with recuperative gas burners of the low $NO_x$ type for a total of 1.5 MW. Measurements will be made to evaluate productivity, energy consumption and emissions.				
SGC 90.65	HEATING OF LIQUIDS AT A CONCRETE PLANT, KOCKS – TRELLEBORG Objective: Demonstration of gas-based heating of liquids at a concrete plant.	SGC	Sydgas	Curr 1990- -1991	Lars Nilsson, SG
	Description: A decentralized liquid neater will be installed at KOCK's concrete plant in Trelleborg. The technique will be evaluated by measurement of emissions, and follow-up of operations and main- tenance costs.				
VF G1-106	FEASIBILITY OF USING GAS WITHIN THE PULP AND PAPER INDUSTRY The investigation's aim is to identify and quantify the feasibility of using natural gas and LGP within the Swedish pulp and paper industry.	Värmeforsk	Jaako Pöyry, Finland	Curr 1991	Per Jerkeman, Pöyry, Olle Olsson, Papyrus, Mölndal
SGC 90.51	CUTTING WITH ACETYLENE AND WITH NATURAL GAS. A COMPARISON Objective: To show that natural gas can replace acetylene in torch cutting of sheet metal without deterioration of quality.	SGC	Sydkraft, TBE section	Curr 1991	Lars Nilsson, SG Åsa Marbe, SK
	Description: A comparison of torch cutting with natural gas and acetylene took place at Bruce's Production Shop, Ltd in Landskrona. The results and compared with regard to quality of cut, cutting speed as well as consumption of fuel and oxygen.				

#### 4. INDUSTRIAL APPLICATIONS

	Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	SGC 90.59	CONVERSION OF ALUMINIUM SMELTING FURNACES. A PRELIMINARY STUDY Objective: To provide information about the technical and economical conditions necessary for converting electric and oil driven aluminium smelting furnaces to operation with gas. Description: The work is being carried out as an investigation even including the market potential in Scandinavia for furnaces with operating temperature	SGC	Sydkraft, TBE section	Curr 1991	Anders Molin, SK Ola Hall, SK
		lower than 1,000 degrees C. The feasibility of furnishing already converted furnaces with heat recovery systems is also being investigated.				
	SGC 90.70	USE OF GAS IN POT FURNACES FOR GLASS <u>Objective</u> : To obtain higher quality glass, lower operational costs and lower NO <sub>x</sub> emission by use of new and improved burning techniques and	NGC, SGC, STU, Glafo and others	Glasforskn- institutet (Glafo), Växjö	Curr 1991- -1993	Stellan Persson, Glafo Per-Arne Persson, SGC
		optimal placement of burners <u>Description</u> : The project will be carried out in three steps: 1) Preliminary studies		1		
i		<ol> <li>Tests in a model furnace at DTI, Malmoe</li> <li>Full scale test smelting at two glass works</li> </ol>				
	SGC 91.02	GAS IR-TECHNIQUES WITHIN INDUSTRY. A PRELIMINARY STUDY AND PRO- GRAMME PROPOSAL. STAGE 1. Stage one consists of an analysis of the area of the programme, including, inter alia, the technical situation, the market conditions, problem areas and development possibilities.	SGC	Sydkraft, TBE section	Curr 1991	Per-Arne Persson, SGC Per Carlsson, SK
	VF G1-101	APPLICATION OF IR-HEATING AT FORBO FORSHAGA <u>Objective</u> : To investigate possible changes in production capacity and quality when there is a transition from electric IR to gas IR.	Värmeforsk	DTI	Curr 1991	Per Carlsson, GE Michael Johansson, DTI
		<u>Description</u> : At Forbo Forshaga an embossing machine produces patterns in PVC carpets. Prior to embossing, the carpet is heated to temperatures of from 180 to 190 degrees C by means of an electric IR. This electric IR will be replaced with a gas IR. Measurements and evaluation of various parameters will take place before and after conversion and will be compared with each other.				

land a subscription of the second

July 1991

### Sheet 4.6

### 4. INDUSTRIAL APPLICATIONS

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
Vf G0-104 SGC 90.63	LABORATORY METHOD FOR DETERMINA- TION OF OVERALL EFFICIENCY FOR IR RADIATORS Objective: Development of methods for determining the overall efficiency of IR radiators. Description: The project is a continuation of SGC 88.09 and includes, inter alia, purchase of a monochrometer which allows the measurement of the entire emission spectrum, even in the case of electrically operated IR radiators.	Värmeforsk STU, SGC	DTI, Malmö	Plan 1991	Michael Johansson, DTI Per-Arne Persson, SGC
VF G0-105 SGC 90.64	GAS-FIRED IR RADIATORS IN PAPER COATERS. A PILOT FACILITY <u>Objective</u> : Clarification of conditions necessary for use of gas-fired IR radiators in facilities for paper coating. <u>Description</u> : Two gas-driven and two electrically- driven IR radiators will be tested separately at Stora Tekniks pilot facility in Säffle.	Värmeforsk/ /SGC, STU, Skogsindu- stirerna	DTI, Malmö	Plan 1991	Sören Dahlin, DTI Olle Olsson, Papyrus VF level 2-project.
SGC 90.57	DIRECT HEATING WITH NATURAL GAS OF A BOTTLE-RINSING MACHINE AT PRIPPS IN GOTHENBURG Objective: Demonstration of the advantages of decentralized heating with gas as compared to conventional central heating. Description: Natural gas fired immersion tubes will be installed in the bottle-rinsing machine at Pripps in Gothenburg. In this project, the heating of the rinsing machine will, however, occur via a heat exchanger. Energy and emission measurements will be carried out as well as follow-up to determine the ease of regulating as well as the operations and maintenance costs.	SGC	Pripps Bryggerier, Gbg and consultancy companies	Plan 1991	
SGC 91.03	MODELLING AND IMPROVING OF HEAT EXCHANGER TUBING FOR HEATING OF LIQUIDS The objective is to produce, through experimentatic a calculation programme for an optimal dimensionin of gas-fired immersion tubing as regards efficiency, emissions, choice of material, tube configuration, etc. (Doctoral thesis)	SGC, STU m fl n, ig	Kemisk Apparattek- nik, LTH	Plan 1991- -1993	Rolf Christensen, ÅF Lars Nilsson, SG

July 1991

#### Sheet 5.1

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	SPACE HEATING WITH NATURAL GAS IR IN NORTH AMERICA Travel report from a study trip in North America.	SwedeGas, ÅF, STATT	ÅF-Sthlm	Compl 1989	Pär Dalin, ÅF-Sthlm STATT-report is available.
	EMISSIONS MEASUREMENTS FOR LOW NO <sub>X</sub> -BURNERS. NYGAARDS GREENHOUSES Measurements for the boiler central's 7 MW boiler with low NO <sub>x</sub> -burner of the Weishaupt G70/2 type show 0 mg/MJ hydrocarbons, 11 mg/MJ CO, and 28 mg/MJ NO <sub>x</sub> .	Sydgas	K W Energi	Compl Apr1989	Per Carlsson, Sydkraft GasCentrum report GC 89.03
	SMART GAS HOUSE An overview of the Smart-House concept.	SwedeGas	STATT	Compl Apr 1989	Thomas Carlqvist, NGC SwedeGasreport is available.
SVSS 88.02	NATURAL GAS TECHNOLOGY FOR SPACE HEATING OF SMALL BUILDINGS Evaluation of space heating systems for heating of small buildings.	SwedeGas, Vattenfall, Sydkraft, BFR	Vattenfall	Compl May 1989	Bo Berggren, SV BFR-report is available.
VF G2-804 SVSS 88.23	FLUE GAS SYSTEMS IN CONNECTION WITH NATURAL GAS COMBUSTION The objective is to compile in a "Smoke stack Handbook" all relevant information on smoke stacks for natural gas fired facilities as well as to up-date older smoke stack data.	Värmeforsk, level 2-proj/ /Sydgas, SwedeGas, Vattenfall, Gbg Energi, Sthlm Energi	KW Energi- produkter AB	Compl Dec 1989	Kjell Wanselius, KWE, N-E Carlstedt, BES, SV Anders Marklund, Sthlm Energi VF report No. 359
SVSS 89.02	IR TECHNOLOGY FOR SPACE HEATING Measurements were carried out in the warehouse at Trelleborg AB.	Vattenfall/ /SV, SG	Vattenfall	Compl Jan 1990	Nils Erik Carlstedt, SV
	$NO_{X}$ - MEASUREMENTS BEFORE AND AFTER CONVERSION TO GAS FIRING (HALMSTAD AMONG OTHER LOCATIONS) Measurements were carried out at five facilities containing, inter alia, a furnace as well as apartment house boilers.	Sydgas/ /SAMKO	Sydkraft	Compl Jan 1990	Per Carlsson, Sydkraft GC report 90.02
VF G8-812	INDOOR AIR QUALITY DURING DIRECT EMISSION OF FLUE GASES FROM NATURAL GAS COMBUSTION A description of environmental consequences from direct emissions as reported in the international literature.	Värmeforsk/ /VF, NGC	TVE	Compl Dec 1990	Ulrika Jantze, TVE VF-report is expected in April of 1991.
	CONVERSION FROM DIRECT ELECTRICAL HEAT TO NATURAL GAS BASED AIR HEATING Single-family houses converted from direct electrical heating to air-borne heating with natural gas as the heat supply. Evaluation of capital and operational costs after ca. one year's operation.	Sydkraft/ /Sydgas 50 %, Sv Fläkt 50 %	Svenska Fläkt and Sydkraft	Compl 1990	Roland Nilsson, Sydgas (No report)

Inten proje desig	nal PROJECT NAME ect Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation
tion		<u> </u>	<u> </u>		Comments, etc.
	HEATING OF VENTILATING AIR WITH GAS	Vattenfall		Compl 1990	J Forsman, SV SV report 90/8
VF G8-8	CONVERSION TO NATURAL GAS, CHANGE IN PERFORMANCE AND EMISSIONS Measurements and evaluation in Varberg (inter alia Monark AB, Arla, Scan Väst).	S Värmeforsk	Statens Provn.anstali	Compl 1990	Lennart Gustavsson, SP VF report No 381
SWC D6.1	DEMONSTRATION OF HEATING SYSTEMS FOR SMALL BUILDINGS Conversion of 2-3 residences in Stockholm and Varberg to gas heating, inter alia with installatio of water-borne socket convectors.	SwedeGas	Vattenfall, BFS section	Compl 1990	Leif Bodinson, SWG SWG report is available.
VF G5-6	CONDENSATING GAS BOILERS FOR A SINGLE FAMILY HOUSE, A FURTHER STUDY The study shall result in guidelines for required re heating in the case that smoke stacks can be used without any modification.	Värmeforsk	LTH, Värme- o Kraftteknik	Compl 1991	Mikael Näslund, LTH
SGC 88.2	PULSATION BOILER IN VELLINGE Evaluation of an existing 250 kW boiler at the Central Clinic in Vellinge in Scania. Inter alia, measurements of efficiency, $NO_x$ , flue gas temperature and sound level will be taken.	Sydgas/ /Sydgas and Sydkraft	Sydkraft, TBE section	Curr 1987- -1991	Per Carlsson, Sydkraft Lars Nilsson, SG
SGC 88.04	EMISSIONS AND ENERGY SAVINGS BEFORE AND AFTER CHANGE-OVER TO NATURAL GAS IN A MULTI-RESIDENT BUILDING (FALKENBERG) Measurements before and after conversion to natural gas at a facility in Falkenberg with a ratin of 500 kW.	Sydgas/ /SGC, SAMKO g	Sydkraft, TBE section	Curr 1988- -1991	Per Carlsson, SK Lars Nilsson, SG
VF G8-8	CONSTRUCTION OF A PROTOTYPE OF A FLUE GAS REHEATING CONDENSATING BOILER Construction of and measurements on a boiler to verify theoretical arguments put forth in an earlie project (VF G5-607).	Värmeforsk	Värme- o Kraft, LTH	Curr 1989- -1991	Mikael Näslund, LTH
VF G8-9	NATURAL GAS FIRED RADIATORS NO <sub>x</sub> measurements on direct-fired radiators in Gothenburg.	Värmeforsk	Göteborg Energi	Curr 1989- -1991	Per Carlsson, GE
SEU 0639	REPLACEMENT OF ELECTRICITY WITH 2 NATURAL GAS IN SINGLE FAMILY HOUSING, LUND In at least five electrically heated residences, natural gas heating was installed as well as equipment for measurement and follow-up.	SEU/ /SEU and others	Lunds Energiverk	Curr 1989- -1992	Christer Böös, Lunds Energiverk

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
STEV 276 430	SYSTEM STUDY OF NATURAL GAS FIRING Doctoral research.	STEV	LTH Värme- och Kraft	Curr 1989- -1993	Project leader: Lennart Thörnqvist, LTH Mikael Näslund, LTH
	HEATING OF VENTILATING AIR Comparison of three different systems.	Vattenfall	Vattenfall Energisystem AB	Curr 1990- -1991	Jonas Forsman, Vattenfall Energisystem AB
SV 98441	INSTALLATION OF NATURAL GAS IN GOVERNMENT BUILDINGS. A study to shed light on:	Vattenfall	Vattenfall	Curr 1990- -1991	
	<ul> <li>– currently available techniques</li> <li>– development requirements for the introduction of such technology in Sweden.</li> </ul>				
	IR-HEATERS AT PRIPPS IN GOTHENBURG Demonstration of IR-radiators for space heating at Pripps Brewery in Gothenburg.	SwedeGas, Göteborg Energi, BFR	Pripps Göteborg, Chalmers Industriteknil	Curr 1990- -1991	
VF G0-102	VERIFICATION MEASUREMENTS FOR A SMOKE STACK MODEL <u>Objective</u> : To take measurements to verify the calculation model developed in project G6-607 (Condensating boiler. Smoke stack activity).	Värmeforsk	Värme o Kraft, LTH	Curr 1991	Mikael Näslund, LTH
	Description: Measurements will be carried out on an existing research smoke stack at Malmoe Energy's gas works. Measurements will include the temperature in the flue gas flow and on the inner wall of the stack as well as the amount of condensed water.				
SGC 90.66	SYSTEM EFFICIENCY IN SMALL BUIL- DINGS WITH CONVERSION FROM WATER- BORNE ELECTRIC HEAT TO GAS <u>Objective</u> : An investigation of the yearly average efficiency that is obtained with a system especially developed for docking of a gas boiler to an electric boiler in small buildings.	SGC	Vattenfall Energi- system AB	Curr 1991- -1992	Svante Dolff, Västgas Jonas Forsman, SV
	Description: Measurements will take place in a converted building in Södra Ängby, Bromma.				
SGC 89.11	A COMPUTER MODEL FOR NATURAL GAS-IR FOR SPACE HEATING The intention of the study is to determine what computer programmes are available as well as to develop a programme for the calculation of power requirements, optimal location, energy requirement and economic consequences.	SGC	Not decided	Plan 1991	Per-Arne Persson, SGC

July 1991

and the state of the second second

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
	REPLACEMENT OF DIRECT ELECTRICAL HEAT WITH WALL BOILERS FOR NATURAL GAS An investigation of the market potential, necessary design modifications, changes in standards and economic consequences.	Malmö Energi	Malmö Energi	Plan 1991	Gert Björklund, Malmö Energi
SV 98442	BUILDING DESIGN IN THE FUTURE: "SMART HOUSES" The goal is to increase knowledge about future building design and its connection to various energy systems.	Vattenfall	Vattenfall, technical institute, building industry	Plan 1991	
SGC 90.68	HUMIDIFYING OF COMBUSTION AIR FOR CONDENSATION BOILERS. A PRELIMINARY STUDY An investigation into the advantages of humidi- fying, especially at relatively high condensation temperatures.	SGC	KW Energi- produkter	Plan 1991	Kjell Wanselius Lars Nilsson, SG

July 1991

#### 6. GAS BASED COGENERATION

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
VF B7-737	EMISSIONS AND ELECTRICAL EFFICIENCY WITH GAS TURBINES AND DIESELS Natural gas, LPG and oil were studied.	Värmeforsk	ÅF	Compl March 1989	Axel Enshagen, ÅF VF repport No. 331
	EXPANDED ELECTRICAL PRODUCTION WITH NG-BASED COGENERATION IN SKOGHALL'S WORKS Different combinations were studied: among others conversion of oil boilers to gas, addition of gas turbines.	SwedeGas	SwedeGas	Compl April 1989	Björn Svensson, SV SWG-report is available
STEV 616 045	A SYSTEMS STUDY OF NATURAL GAS BASED FUEL CELL POWER PLANTS	STEV	Kemisk Teknologi, KTH	Compl June1989	Proj.leader: Lars-Peter Wiktorsson, Kemisk Teknologi, KTH STEV FoU-rapport NYEL-89/2 Studsvik's library
STEV 616 051	THE SIGNIFICANCE OF FUEL STORAGE IN THE GENERATION OF POWER AND HEAT WITH NATURAL GAS	STEV/STEV, Gbg Energi	Energisystem- teknik, CTH	Compl Oct 1989	Proj.leader: Claes Otto Wene, Energisystem- teknik, CTH STEV FoU-report VK-89/6 Studsvik's library
SV 98452 02038	CALCULATION METHODS FOR SMALL- SCALE COGENERATION PLANTS A calculation model was developed as an aid for evaluation of small-scale cogeneration plants.	Vattenfall	Vattenfall, BEP section	Compl Dec 1989	Lars Winter, BEP, SV Internal report only.
	REQUIRED NATURAL GAS PRESSURES FOR GAS TURBINE AND GAS ENGINE BASED POWER AND COGENERATION PLANTS The results indicate the following pressure levels needed: Gas turbines max 24 bars Diesel motors 4 bars Otto cycle engines 4 bars	SwedeGas	Vattenfall	Compl 1989	Thomas Carlqvist, NGC SWG-report is available
VF E7-811	THE TECHNICAL STATUS OF GAS ENGINES A survey of the technical status of gas engines suitable for, by way of example, heat pumps as regards performance, standard units, reliability, safety and maintenance.	Värmeforsk	ÅF	Compl Oct 1990	Lars Wrangensten, ÅF Report in springtime of 1991.
	PRINCIPLES FOR CONNECTION TO HEATING SYSTEMS AND ELECTRICAL GRIDS	Vattenfall	Vattenfall Energisystem AB	Compl 1990	Tove Ekeborg, Vattenfall Energi- system AB
	COGENERATION FOR ISOLATED FARMS	Vattenfall		Compi 1990	A Bengtsson SV report 90/13

Sheet 6.1

### July 1991 Sheet 6.2

#### 6. GAS BASED COGENERATION

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SGC 89.14	MICRO-COGENERATION PLANTS FOR GREENHOUSES Measurements and evaluation of microcogenera- tion plants for greenhouses in Helsingborg.	Helsingborgs Energiverk/ /GasCentrum	Kjessler & Mannerstråle	Compl 1991	Göran Persson, HE Roy Ericsson, K&M Report SGC 002
	NATURAL GAS DRIVEN FUEL CELLS 200 kV Planning, purchasing, installing, operating, main- taining and evaluating of a 200 kW fuel cell of the phosphoric acid type.	Sydkraft/ /Sydkraft STEV, SSF	Sydkraft	Curr 1987-	Lars Sjunnesson, SK Per Carlsson, SK
	LIMHAMN'S HEATING PLANT. REBURNING WITH NATURAL GAS Reburning with natural gas is tested in a 125 MW pulverized coal boiler in Limhamn. The results will serve as a basis for, inter alia, mathematic modelling of reburning.	SEU, STEV, Malmö Energi	Malmö Energi AB (Limhamn)	Curr 1988- -1991	Olle Göransson, ME
STEV 566 002	DIESEL/CFB-BOILER Study of a diesel/CFB-boiler for heat-and-power generation with low NO <sub>x</sub> properties.	STEV	Energiteknik, CTH	Curr 1988- -1991	Proj.lead: Bo Leckner, Energiteknik, CTH
STEV 566 007	STUDY OF THE STIG-SYSTEM FOR COGENERATION Research and education project.	STEV	Värmeteknik, KTH	Curr 1988- -1991	Proj.lead: Gunnar Svedberg, Värmeteknik, KTH
STEV 566 009	GAS COMBI SYSTEM Research and education project.	STEV	Värme- och Kraftteknik, LTH	Curr 1988- -1991	Proj.lead: Tord Torisson,Värme- och Kraftteknik, LTH
STEV 566 010	OPTIMIZATION OF COGENERATION SYSTEMS Research and education project.	STEV	Värme- och Kraftteknik, LTH	Curr 1988- -1991	Proj.led: Tord Torisson, Värme- och Kraftteknik, LTH
STEV 616 048	INTERNAL REFORMING OF NATURAL GAS IN MOLTEN CARBONATE FUEL CELLS Research and education project.	STEV	Kemisk Teknologi, KTH	Curr 1988- -1991	Olle Lindström, KTH
STEV 565 002	THE COGENERATION PLANT IN STENUNGSUND LPG-engine for electrical production and heat pump operation in the Stenungsund 600 kWe plant. Follow-up of performance.	STEV	Stiftelsen Stenungsund Fjärrvärme and CTH	Curr 1989- -1991	Sten Åfeldt, STEV
	NO <sub>X</sub> REDUCTION IN NATURAL GAS FIRED COGENERATION PLANTS Conversion to natural gas has been carried out in the Heleneholms power and heat plant in Malmo. NO <sub>x</sub> emission of ca 100 mg/MJ. The project in- volves reducing NO <sub>x</sub> contents to under 50 mg/MJ by using various measures of combustion technology	SEU/ /SEU, Malmö Energi gy.	Malmö Energi and Värme- o ugnsteknik, KTH	Curr 1989- -1991	Lars Flinck, Malmö Energi AB Rolf Collin, KTH

#### Sheet 6.3

#### 6. GAS BASED COGENERATION

Internal project designa- tion_	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
STEV 616 077	MOLTEN CARBONATE FUEL CELLS Basic research. (A research and education project)	STEV	Teknisk Elektrokemi, KTH	Curr 1989- -1991	Daniel Simonsson, KTH
SV 98454 06030	SMALL GAS ENGINES FOR HEAT AND POWER A study of one or more typical cases for sizes of less than 1MW with reference to technology and cost. Elucidation of optimal layout for an actual ca	Vattenfall	Vattenfall, BES section	Curr 1989- -1991	Annika Bengtsson, SV
	REMOTE CONTROL AND MONITORING OF SMALL COGENERATION PLANTS	Vattenfall	Vattenfall Energisystem AB	Curr 1989- -1991	Johan Danelius, Vattenfall Energisystem AB
STEV 566 015	DEVELOPMENT IN GAS ENGINE TECHNOLOGY General programme of research and development.	STEV, STU	Värme- o Kraft, LTH	Curr 1989- -1992	Gunnar Lundholm, KTH
STEV 616 038	THE INTEGRATION OF NATURAL GAS IN EXISTING ELECTRICAL POWER SYSTEMS Research and education project.	STEV, Vattenfall	Elektriska Energisystem, KTH	Curr 1989- -1992	Göran Andersson, KTH
STEV 566 022	PARTIAL LOAD PROPERTIES IN GAS COMBI PLANTS FOR POWER PRODUCTION AND COGENERATION Research and education project.	STEV	Värme- o Kraft, LTH	Curr 1989- -1992	Tord Torisson, Värme- o Kraft, LTH
STEV 566 024	TWO-MEDIA PROCESSES FOR POWER PRODUCTION AND COGENERATION PLANT Research and education project.	STEV S	Värmeteknik, KTH	Curr 1989- -1992	Gunnar Svedberg, KTH
STEV 566 006	METHODS FOR THE ANALYSIS OF MEASURES FOR THE INCREASE OF EFFICIENCY AND THE LIMITATION OF EMISSIONS IN COGENERATION SYSTEMS Research position.	STEV	Värme- o Kraft, LTH	Curr 1989- -1992	Tord Torisson, Värme- o Kraft, LTH
	DEMO AND EVALUATION OF OTTO CYCLE ENGINES	Vattenfall	Vattenfall Energisystem AB	Curr 1990- -1991	Anders Tvärne, Vattenfall Energisystem AB
	DEMO AND EVALUATION OF FUEL CELLS	Vattenfall	Vattenfall	Curr 1990- -1991	Nils-Erik Carlstedt, SV
STEV 564 006	EVALUATION OF GAS TURBINES FOR LPG CONNECTED TO A SOLID FUEL BOILER IN SANDVIKEN	STEV	Sandviken Energi, Vattenfall	Curr 1990- -1994	Sten Åfeldt, STEV

#### 6. GAS BASED COGENERATION

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SGC 90.67	INCREASED POWER PRODUCTION IN EXISTING COGENERATION PLANTS WITH HELP OF NATURAL GAS <u>Objective</u> : To shed light on various alternative courses of action that can supplement existing cogeneration plants by using natural gas. <u>Description</u> : A case study will be carried out at Örebro Energy's cogeneration plant in Örebro, the results of which will be developed so as to be	SGC/ /SGC, Öre- bro Energi	Örebro Energi and Galbe (Kon- cultancy firm)	Сит 1991	Håkan Ekegren, Örebro Energi
	useful in a more general context. SMALL SCALE COGENERATION PRODUCTION Construction, operation and evaluation of three gas engine driven aggregates (Kockums Fritid, PLM and Gasverket).	Malmö Energi	Malmö Energi	Curr 1991- -1992	Lennart Bengtsson, ME
EP 0770	NATURAL GAS BASED COGENERATION WITH GAS TURBINES Demonstration of a combustion chamber of low NO <sub>x</sub> type.	Lunds Energi- verk/SEU	Lunds Energiverk	Curr 1991- -1994	Jonas Eck, LE
STU 90-161	INTERNAL PRODUCTION OF ELECTRICITY WITHIN THE IRON AND STEEL INDUSTRY Investigation.	STU	Jernkontoret	Curr 1991	
	STIRLING ENGINE Installation, adaptation to heating system and follow-up of a Stirling engine aggregate (elec- tricity and heat) developed at TEM in Malmoe.	Malmö Energi	Malmö Energi	Plan 1991- -1992	Lennart Bengtsson, ME
SGC 90.69	NO <sub>x</sub> REDUCTION BY REBURNING WITH NATURAL GAS/LAND FILL GAS. FULL SCALE TEST AT SYSAV'S REFUSE HEATING PLANT IN MALMOE <u>Objective</u> : To demonstrate whether it is possible to reduce NO <sub>x</sub> emissions from refuse incineration facilities by reburning with natural gas and/or biogas. <u>Description</u> : SYSAV's refuse incineration facility in Spillepengen in Malmoe is supplied with reburning equipment for gas. Measurement of emissions, temperature, boiler load, etc. will be carried out and adjustments will be made so as to make reburning as effective as possible.	SGC, NGC SNV, REFORSK, SYSAV and others	SYSAV, Malmö	Plan 1991- -1992	Erik Nord, SYSAV Lars Nilsson, SG

July 1991

#### Sheet 7.1

#### 7. OTHER USES OF GASES

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SVSS 89.01	CO <sub>2</sub> REDUCTION WITH THE AID OF NG- DRIVEN VEHICLES A market study that indicates a potential of 10 TWh annually for natural gas for vehicles. This represents a reduction of 330 kt per year of CO <sub>2</sub> at lean burn conditions and 195 kt annually CO <sub>2</sub> with a 3-way catalyzer.	SVSS	Vattenfall	Compl Oct 1989	Nils Eric Carlstedt, SV
	NATURAL GAS AS FUEL FOR RECIPRO- CATING ENGINES Investigation into the feasibility of using natural gas for traction engines and stationary engines, with low exhaust emissions.	STU	Consultant	Compl 1989	STU-INFO No. 751-1989
	A MARKET SURVEY OF NATURAL GAS DRIVEN VEHICLES IN SWEDEN	SwedeGas	Ekens fordons och trafikkon- sult AB	Compl 1989	Mats Ekelund, EkoTraffic Report is available.
	HOME-REFUELING OF NG-DRIVEN VEHICLES	Vattenfall	Vattenfall	Compl 1990	T Ekeborg, SV SV report 90/5
	PRESSURE VESSELS FOR NATURAL GAS DRIVEN VEHICLES	Vattenfall	Vattenfall	Compl 1990	M Losciale SV report 90/15
SGC 89.09	THE ENVIROMNENTAL IMPACT OF EXHAUST EMISSIONS FROM VEHICLES Objective: To make a study of the literature in order to document exhaust emissions from vehicles that operate with various fuels. Description: The material shall be used mostly in discussions and debates about the effect of various vehicles that use various fuels.	TFB, SNV, SWG, SV, SG, EiG	EcoTraffic AB	Compl 1990	Mats Ekelund, Ecotraffic SV reports 90/62 and 90/63 with the title "Automotive fuels from source to end use. Phase 1".
SV 98454 07010 SVSS 88.15	NATURAL GAS DRIVEN VEHICLES- DEVELOPMENT OF ENGINES FOR CITY BUSES (THE NORDIC GAS-BUS PROJECT) STAGE 1 Aims at optimizing, in a laboratory environment, two types of bus engines for operation with na- tuaral gas so as to obtain low exhaust emissions.	Nordisk industrifond, STU Vattenfall, Sydkraft, SwedeGas and others	Traffic comp, engine manu- factures, Vattenfall and others	Compl 1991	Tove Ekeborg, SV Proj.lead: Mats Ekelund, EcoTraffic Report in springtime of 1991.
	NATURAL GAS DRIVEN VEHICLES – – DEMONSTRATION OF NATURAL GAS BUSES IN MALMOE	TFB, Malmö Energi AB, Malmö Lokal trafik	Malmö Energi AB, Malmö Lokaltrafik	Curr 1988 -1991	Åke Svensson, Malmö Lokaltrafik. The first bus was operational Oct 1989
	NATURAL GAS FOR INDUSTRIAL TRUCKS. A PRELIMINARY STUDY Investigation into the conditions necessary for using natural gas as a fuel in place of LPG, diesel or electricity.	Lunds Energi- verk/Gas- Centrum	Sydkraft, TBE section	Curr 1990- -1991	Lars-Göran Nilsson, LE Åsa Marbe, SK

July 1991

#### Sheet 7.2

#### 7. OTHER USES OF GASES

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SGC 89.10	CO <sub>2</sub> PLANT CULTIVATION WITH EXHAUST GASES FROM NATURAL GAS FIRED BOILERS <u>Objective</u> : To show, above all for governmental authorities involved, that direct emission of flue gases from natural gas combustion in greenhouses can take place without health risks and also to verify expected increase in production. <u>Description</u> : CO <sub>2</sub> -plant cultivation with exhaust	SGC	Sydgas	Curr 1990- -1991	Lars Nilsson, SG
	from natural gas boilers were installed at Nygaard's Greenhouses in Halmstad. The air quality in the greenhouses will be measured as well as the production of vegetables, etc. The latter will be compared with the values obtained before CO <sub>2</sub> - plant cultivation was introduced.				
SGC 90.50	HOME-REFUELING OF NATURAL GAS DRIVEN VEHICLES <u>Objective</u> : To obtain experience of home-refueling through demonstration for approximately one year.	SV, SWG, SG, ME, GE, STU	Vattenfall Energisystem AB	Curr 1990- -1992	Tove Ekeborg, SV Svante Dolff, Västgas
	<u>Description</u> : A home-fueling unit for automobiles that have been converted to natural gas was in- stalled at a family home in Varberg. The experience with such units will be evaluated for later use on a larger scale.				
SGC 90.58	NATURAL GAS FUEL STATION FOR VEHICLES Four small standard compressors for natural gas will be connected in parallel and will be placed, together with a gas storage battery, in a mobile container. The equipment will be used during the first year as a fuel station for natural gas buses in Gothenburg.	SGC	Göteborg Energi AB	Plan 1991	Einar Änghede, GE
	· · · · · · · · · · · · · · · · · · ·				

July 1991

Sheet 8.1

#### 8. MEASUREMENT TECHNOLOGIES

Internal project designa- tion	PROJECT NAME Project description	Purchaser/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SV 98452 05011	SATELLITE DETERMINATION OF POSITION Measuring in of 10 points from Project Västgas AB, using GPS, Global Positioning System (a satellite system).	Vattenfall	КТН	Compl April 1989	Anna-Kajsa Ström, BEL, Vattenfall
	ACCURACY IN FLOW-MEASUREMENTS OF NATURAL GAS	Vattenfall		Compl 1990	K Steen SV report 90/11
VF G8-903	INSTRUCTIONS FOR MEASUREMENTS ON GAS ENGINES The work aims at developing guidelines and instructions for how emission measurements, etc. should be carried out on gas engines.	Värmeforsk	VIAK	Compl March 1991	Lennart Eriksson, VIAK, Vänersborg
SV 98452 03011	FOLLOW-UP OF GAS-FLOW METERS Investigation of accuracy of gas meters for customer billing.	Vattenfall	Vattenfall, BEP section	Curr 1988- -1991	Rolf Mattsson, BEP, Vattenfall
STEV 656-085 VF G8-912	ABSOLUTE CALIBRATION OF GAS FLOW METERS BASED ON ULTRASONICS Measurement of the developed ultra sonic meter (see project G3-405) against a calibrated reference can establish performance in absolute measure for the ultrasonic technique.	Värmeforsk, STEV	Värme- o Kraftteknik, LTH	Curr 1988- -1991	Jerker Delsing, Värme- o Kraftteknik, LTH
		-			
				,	
ļ					

#### 9. ADDITIONAL AREAS OF INTEREST

المراجعة فتستعد المراجع

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SVSS 89.04	INSURANCE MODIFICATIONS CAUSED BY INSTALLATION OF GAS IR In the report it is established that the insurance industry's view on gas-fired IR-radiators is liberal and that, whenever such equipment was involved, only marginal fire-protection measures were require	SwedeGas d.	VIAK	Compl Sept 1989	Thomas Carlqvist, NGC SwedeGas report is available.
	NATURAL GAS IN NORTH AMERICA	SwedeGas	ÅF, Sthlm	Compl 1989	Thomas Carlqvist, NGC Report is available.
STU 89-1655	NATURAL GAS IN SCANDINAVIA An investigation into the infrastructure relating to natural gas for operation of vehicles.	STU TFB EFN Nordiskt Ministerråd	Ekonomisk historia, Göteborg University	Compl Nov 1990	Sven-Olof Olsson, GU
VF G8-906	CARBON DIOXIDE EMISSION AND ITS ENVIRONMENTAL CONSEQUENCES A survey of the state of knowledge as regards the consequences of carbon dioxide formation with various types of fuels and power plants.	Värmeforsk	LTH, Värme och Krafttek- nik	Compl Dec 1990	Per Rosén, Värme- o Kraftteknik, LTH Handl: Tord Torisson, Värme- o Kraftteknik, LTH VF report No 373
VF G2-701	DISPERSION OF NO <sub>X</sub> FROM NATURAL GAS FIRED BOILERS	Värmeforsk, level 2- projekt	FTC	Compl 1990	Göran Holmstedt, FTC
SK 90.32	OPTIMAL PURCHASING METHODS FOR LPG TERMINALS Evaluation of partial purchasing versus total contracting. Examples of actual application: Karlshamn and Sundsvall.	Sydkraft/SSF	LTH	Compl 1991	Sigvard Trönell, TBE, Sydkraft Prof Jan Söderberg, LTH Report is available.
	OPERATION AND MAINTENANCE HAND- BOOK FOR RECIPROCATING ENGINE DRIVEN COGENERATION PLANT	Vattenfall	Vattenfall Energisystem AB	Compl 1991	Christer Sandstedt, Vattenfall Energi- system AB Report in press (April 1991)
VF	RESOURCES AND COMPETENCE WITHIN SWEDISH GAS TECHNOLOGY RESEARCH Objective: A survey of the resources and compe- tence in Swedish institutions, firms and organiza- tions within the area of gas technology.	Värmeforsk	Energi- konsult A Bauer AB	Compl 1991	A C Bauer Jörgen Thunell, SGC
	<u>Description</u> : The survey shall, inter alia, be of use when evaluating the qualifications of different institutions and firms to carry out specific research and development tasks.				

July 1991 Sheet 9.1

#### 9. ADDITIONAL AREAS OF INTEREST

Internal project designa- tion	PROJECT NAME Project description	Ordered by/ /Financed by	Carried out by	Time Schedule	Project leader Contact person Report designation Comments, etc.
SWG 88.12	OPERATIONS AND MAINTENANCE HANDBOOK	Vattenfall	SGF, Vattenfall	Curr 1988- -1991	
VF G8-813	DISPERSION MODEL ADAPTED FOR USE WITH PERSONAL COMPUTERS Development of a PC programme with a model for describing critical pollution levels from small, free-standing natural gas fired plants.	Värmeforsk	SMHI	Curr 1989- -1991	Sture Ring, SMHI
	OPERATION AND MAINTENANCE HAND- BOOK FOR LPG PLANTS	Vattenfall	Vattenfall Energisystem AB	Curr 1989- -1991	Christer Sandstedt, Vattenfall Energi- system AB
SV 93756	GAS SAFETY. A SURVEY The study shall result in guidelines for the analysis of instances of error and for the calculation of emissions. It will also propose measures for the reduction of the risk of gas leakage, for the limitation of the quantities of gas emitted, for the prevention of explosions as well as for the reduction of the consequences of an explosion.	Vattenfall	Vattenfall	Curr 1991	Rolf Mattsson, SV
SK 90.17	ODORIZING Analysis of problems in connection with odorizing of natural gas and recommendations for improvements.	Sydgas/ /Sydkraft	Sydkraft	Plan 1991	Niclas Widing, SG
:					
				,	

# Addresses of certain of the companies and organizations referred to in the project catalogue

Byggforskningsrådet S:t Göransgatan 66 112 33 STOCKHOLM

Drifttekniska institutionen vid LTH Stora Varvsgatan 11 H 211 20 MALMÖ

Energigasinstitutet vid LTH Box 118 221 00 LUND

Göteborg Energi AB Box 53 401 20 GÖTEBORG

Förbränningstekniskt Centrum i Lund LTH Box 118 221 00 LUND

Inst för Elektrisk Mätteknik LTH Box 118 221 00 LUND

Inst för Värme- och Kraftteknik LTH Box 118 221 00 LUND

Inst för Värme- och Ugnsteknik KTH 100 44 STOCKHOLM

Malmö Energi AB Box 50510 202 50 MALMÖ

Nordisk Gasteknisk Center Dr. Neergårdsvej 5 DK-2970 HÖRSHOLM Danmark

Statens Energiverk 117 87 STOCKHOLM

Stiftelsen Värmeteknisk Forskning (Värmeforsk) Box 6405 113 82 STOCKHOLM

Studsvik Energiteknik AB 611 82 NYKÖPING

Styrelsen för Teknisk Utveckling Box 43200 100 72 STOCKHOLM Svensk Energiutveckling AB Box 3192 103 63 STOCKHOLM

Svenska Gasföreningen Box 6405 113 82 STOCKHOLM

SwedeGas AB Box 12530 102 29 STOCKHOLM

Sveriges Tekniska Attachéer Box 5282 102 46 STOCKHOLM

Sydbränsle AB Stora Varvsgatan 11 B 211 20 MALMÖ

Sydgas AB Box 19006 200 73 MALMÖ

Sydkraft AB 205 09 MALMÖ

Sydkraft AB:s Stiftelse för Forskning 205 09 MALMÖ

**Terminalgas AB** Box 84 374 22 KARLSHAMN

**Theorell och VBB Energikonsulter (TVE)** S:t Eriksgatan 117 113 43 STOCKHOLM

Tumab Box 718 261 27 LANDSKRONA

Vattenfall 162 87 VÄLLINGBY

VIAK AB Mölndalsvägen 85 412 85 GÖTEBORG

Västgas AB Box 224 401 23 GÖTEBORG

ÅF Energikonsult AB Stensjögatan 3 217 65 MALMÖ

**ÅF Energikonsult AB** Box 8133 104 20 STOCKHOLM Appendix 1(1)



Box 50525, 202 50 MALMÖ Telefon: 040-700 40 Telefax: 040-30 50 82

KF- Sigma, Lund 1991