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BEIJING SPECIALITY GAS RESEARCH AND DEVELOPMENT CENTRE

DP/CPR/85/005/11-01

PEOPLE'S REPUBLIC OF CHINA

Fifth Status Report*

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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Vienna

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ABSTRACT

This fifth status report of the CTA for Beijing Specialty Gas Research Institute describes a 14 day visit (October 13, 1988 to October 17, 1988). Three types of activities are reported. They are a review of the current activities (Expert Requirements, Fellowships; Equipment, etc.); a general survey of the accomplishments of the project and developing data for a follow-on project. Annex A contains the job descriptions for those Experts still required. Annex B is the Report of the Expert in Computer Software.

INTRODUCTION

This report describes the activities of the Chief Technical Advisor during his fifth visit to Beijing, China to review and monitor the activities of Project DP/CPR/85/005; Beijing Specialty Gas Research Institute (BSGRI). The basic report has four sections: These are Job Descriptions, Instrumentation and Equipment; Study Tours and Fellowships.

Additional information is given on the accomplishments of the project.

Other information in the report relates to developing data for the preparation of a Project Document for a follow-on project.

JOB DESCRIPTIONS

There has only been slight changes in the requirements for experts than those which were shown in the Fourth Status Report of the CTA. The following comments relate to the current requirements for experts. The numbering system is the same as in previous reports. These requirements have been reviewed with and approved by Mr. Chen, Director of the Institute.

1. #11.01; Chief Technical Advisor

This report outlines the activities of the CTA during this most recent visit. It would appear that one more (final) visit on this project will be required in May of 1989. The purpose of this final visit will be to prepare a final report on the activities and achievements in the current project and to attempt to prepare and finalize any data or other requirements for the follow-on project. A modified job description is contained in Annex A.

5. #11.05; Expert in the Utilization of Gases and Gas Mixtures for Food Ripening and Food Preservation.

This expert is still required. During Me Chen's (Project Director) visit in the United States on the last Study Tour, he had contacted an appropriate candidate. However that candidate had not been able to be located (or at least had not responded by May of 1988 to Mr. Hand's UNIDO Recruitment) solicitations. That expert is still recommended and every effort should be made to recruit him. He is:

Dr. Wang, Chien Yi, PhD.
Research Horticulturist
Horticulture Crops Marketing Laboratory
Agriculture Research Center
U.S. Dept. of Agriculture
Room 113, Bldg. 002
BARC - West
Beltsville, MD 20705

8. #1108; Expert in Equation of State for Gaseous Computer Program

This expert completed his mission in mid-summer of 1988. A report

of his activities as prepared by BSGRI personnel is included as Annex B.

9. #11.09; Expert in Standard and Calibration Gases.

This expert is also still needed. As in #11.05, Mr. Chen had "recruited" a potential candidate for this job during his last Study Tour in the United States. That candidate is:

Mr. William Dorko
Office of Std. Phyc. Mat'ls.
National Bureau of Standards
Room B 332, Bldg. 222
Gaithersburg, MD 20899

11. #11.11; Expert in Gas Blending and Analysis.

This expert is still required. Mr. Lindenmoyer has been recruited and has accepted this post. Delays in performing his mission have been caused by the inability to repair the vapor phase chromatography apparatus which was damaged in shipment. As soon as the repairs are accomplished and the apparatus is performing satisfactorily, the mission should be initiated.

INSTRUMENTATION AND EQUIPMENT

Other than very minor problems in acquiring some of the equipment and the problem with having the V.P.C. instrumentation repaired, this portion of the project is essentially completed.

Equipment in the form of Texts, data sheets, manuals, etc. has as of this writing all been ordered in accordance with the recommendations of the original project document. Some minor problems were experienced in this area. The CTA has assisted here with the procurement personnel in UNIDO.

The problem with repairing inter-connecting wiring on the recently purchased high sensitivity vapor phase chromatography seems to be simple to resolve; always being accomplished in the "next few days"; but never completed. The lack of the ability to accomplish these repairs has seriously hampered the timetable on the use of experts as a part of the training of BSGRI personnel. Every effort should be made to put pressure on the vendor to accomplish these repairs necessitated by damage in shipment of the analytical instrumentation.

STUDY TOURS

No additional reports on the two Study Tours which were conducted for Institute personnel have been developed since the last (June 1988) CTA report.

FELLOWSHIPS

All of the problems described in the last report of the CTA in placing the six fellows have been resolved and the six are presently enrolled at Lehigh University. As of this writing, they are completing their first semester.

Just prior to forwarding this report (prior to its being typed), it was learned by TELEX from BSGRI that the Chinese government had approved funds for three of the fellows to continue at Lehigh through the Summer and Fall Semesters of 1989. Personnel in the UNIDO office in Beijing are having difficulty in getting approval from UNIDO, Vienna for additional living allowance for these three fellows for the seven additional months for each.

The three persons who have been granted the extension are Messrs.: Li, Wei; Luo, Gang and Meng, Wen Zhi.

All of these gentlemen are in the advanced chemical engineering curricula.

PROJECT ACCOMPLISHMENTS

In reviewing the accomplishments of the project, it might appear appropriate to describe the utilization of experts, Study Tour values, utilization of purchased analytical equipment, placement of fellows and etc.; however, it would appear more appropriate to describe the tangible results of all of the above activities.

In this latter regard, the project had many objectives which should have resulted in many additional outputs.

The CTA has taken the liberty of condensing these objectives and outputs as follows:

1. The original interest of the project was to establish four basic centers for specialty gas technology within the Beijing Specialty Gas Research Institute. Technical data and assistance to other areas of PRC in these particular disciplines were to be made available. These four centers have been established and they are:
 - a. A National Institute of Safety and Toxicology Data on Industrial and Specialty Gases.
 - b. Advanced analytical capability to meet the exacting needs of analysis for high purity industrial and specialty gases to satisfy the electronic and other similar "sophisticated" industries.
 - c. A National Center for Gaseous Calibration Standards so as to assure their accuracy as they are used for calibrating air pollution and monitoring analytical equipment.
 - d. A national center for developing gaseous mixtures for use as atmospheres for ripening and preserving fruits and vegetables.

This latter center has only just begun to "prick the surface" of learning the technology associated with food preservation and ripening. A large portion of the proposed follow-on project is devoted to these activities.

2. In addition to the development of the four technical centers at BSGRI, it was also proposed that four new products would be

developed for use in the gas industry in PRC.

The four products and the industry they serve are listed below:

- a. Ultra high purity (electronic grade) anhydrous hydrogen chloride for use in silicon wafer etching in the electronics industry.
- b. Ultra high purity (electronic grade) ammonia for use in nitriding processes in the electronics industry.
- c. Ultra high purity silane for use in epitaxy in the electronics industry.
- d. Ultra high purity phosphine for use as a dopant in the electronics industry.

Other new products were also developed as a result of "fall-out" of the technology learned in developing the above named products .

These additional products are:

- a. Medical (USP) Grade nitrous oxide.
- b. "Food Grade" carbon dioxide.
- c. Food preservation gas mixtures.
- d. Complex calibration standards.

FOLLOW-ON PROJECT

With the encouragement of UNIDO Representatives, a large portion of the CTA's activities during this visit was to develop data necessary to prepare a second project as a follow-on to the current project. An outline of what is proposed in this second project follows:

- I. New Products or Product Technology.
 - A. Ultra high purity gases and new gases.
 1. Purification of sulfur hexafluoride.
 2. Production of pure fluorine and a method to produce carbontetrafluoride from fluorine and carbon.
 3. Production of dichlorosilane and silane from an "impure" trichlorosilane.
 - B. Additional ultra high purity gases.
 1. Oxygen, nitrogen and argon from 99.99% pure to 99.999% pure.
 2. Anhydrous hydrogen chloride from 99.99% pure to 99.999% pure.
 3. The ability to measure metal particulates in high purity industrial gases.
 4. The ability to clean gas cylinders and gas piping to contain and retain the low particulate levels in high purity industrial gases..
- II. New Technologies in Gas Blending.
 - A. Improved computer technology for gaseous mixtures.
 1. Larger computer with software to handle multi-component mixtures.
- III. Expanded Capabilities in Studying and Producing Gaseous Atmospheres for Fruit and Vegetable Preservation.
 1. Develop techniques for humidity measurement and control.
 2. Ambient temperature storage only.
- IV. Low Temperature Freezing and Storage of Shrimps and Prawns.
 - A. Construct a Quick Freezing Research Laboratory:
 1. Freezing at very low temperatures.

- a. "Individual piece" pretreatment technology (before freezing).
 - b. Goal of bacterial count to be less than 10,000/gm.
 - c. Relate the technio-economical bases for each type of low temperature freezing; e.g. carbon dioxide versus liquid nitrogen versus low temperature fluids (Freon®) versus conventional mechanical "cold blast" techniques.
2. Storage Parameters.
 - a. Use -40°C "Standard".
 - b. Investigate post-freezing techniques.
 - (1) Ice coatings versus no ice coatings.
 - (2) Types of packaging.

V. Equipment and Construction Requirements.

A. UNDP Inputs

1. Fluorine cell, rectifier and scrubbing and compression equipment.
2. Particulate Measurement apparatus.
3. Resistance probes for measuring resistivity of epitaxy from silane and dichlorosilane depositions.
4. "Medium size" computer with 5 terminals to handle multi-component mixture calculations.
5. Humidity measurement apparatus for use in seven separate fruit and vegetable storage "units".
6. Insta-Cool quick freeze continuous and immersion type freezer with capacity of 50 kg/hr.
7. Carbon dioxide quick freeze tunnel with capacity for 50 kg/hr.
8. Automatic packaging line for frozen shrimp.
9. Deveining machine for shrimp.

B. PRC Inputs.

1. Building, Equipment and Utilities for fluorine and CF₄ production (approxiamtely 800,000 RMB)
2. Silane and dichlorosilane production equipment, building and design and miscellaneous costs (approximately 900,000 RMB).
3. Equipment for multi component gas mixture facility (approximately 400,000 RMB).

4. Building and equipment for gaseous atmospheres for fruit and vegetable storage (approximately 1,200,000 RMB).
5. 200 M² laboratory for studying quick frozen shrimp and their storage to meet international sanitary regulations (approximately 220,000 RMB).
6. Installation of packaging apparatus and equipment to measure bacterial growth (approximately 150,000 RMB).
7. Cold storage facility to store shrimp frozen by various techniques (approximately 800,000 RMB).
8. Purchase of 5 packaging machines for preparing 2 Kg packages (approximately 60,000 RMB).
9. 2 transport trucks, 5 tons each utilizing liquid nitrogen technology for studying transport phenomena and to transport frozen shrimp from production facility to laboratory (approximately 500,000 RMB).
10. 1,000 M² storage building for storage of frozen shrimp (approximately 600,000 RMB).

VI. PRC Personnel Requirements (3 Year Term).

- A. Fluorine and CF₄ production = 14
- B. SF₆ Purification = 12
- C. Gas blending and Cylinder treatment = 14
- D. Industrial gas upgrading = 22
- E. HCl upgrading = 10
- F. Silane and dichlorosilane from trichlorosilane = 22
- G. Shrimp and Prawn quick freezing, storage studies, etc. = 20
- H. Fruit and vegetable storage atmospheres studies = 10

VII. Expert Component (UNDP).

- A. CTA
Two 2 week trips each of 3 years of project = 6 man weeks.
- B. Silane and dichlorosilane production.
Two trips; one 2 week and one four weeks = 6 man weeks.

- C. Fluorine and CF_4 Production.
Two trips; one 2 weeks and one 4 weeks = 6 man weeks.
- D. Purification of industrial gases.
One trip for 3 weeks = 3 man weeks.
- E. Software and Computer Expert for Multi-component mixtures.
One trip for 3 weeks = 3 man weeks.
- F. Preparation of High Purity Gas Mixtures.
One trip for 3 weeks = 3 man weeks.
- G. Techniques in Immersion (Freon®) quick freezing.
Two trips; 2 weeks each = 4 man weeks.
- H. Ambient temperature gaseous atmospheres for fruit and vegetable preservation.
One trip for 3 weeks = 3 man weeks.
- I. Techniques in carbon dioxide tunnel freezing.
One trip for 2 weeks = 2 man weeks.
- J. Handling, pretreatment and other preparatory and storage techniques for frozen shrimp.
One trip for 3 weeks = 3 man weeks.
- K. Post-freezing techniques in handling frozen shrimp (including analysis techniques for bacterial content).
One trip for 3 weeks = 3 man weeks.

VIII. Study Tour Components.

- A. Study frozen food industries in various latitudes. Suggest Australia, Singapore, Thailand, S. Korea and Taiwan.
5 person tour for 1.5 months.
- B. Study ambient gaseous storage atmospheres for storage and preservation of fruits and vegetables.
6 person tour for 1.5 months.

IX. Fellowships

- A. Continuation of advanced chemical engineering studies.
2 people @ 1 year each.

B. Management training in the industrial and specialty gas industries in USA, Japan or a European country.

4 persons total; one year each in each of following:

1. Production of industrial and specialty gases.
2. Marketing of industrial and specialty gases.
3. Applications of industrial and specialty gases.
4. Development technologies in industrial and specialty gases.

X. Other Components.

The PRC component of expenses will also include the cost of utilities, engineering and design of buildings and laboratories, additional compression and process equipment plus unpredictable costs.

The total monetary input by PRC is estimated to be approximately 3,200,000 RMB.

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
UNIDO
PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION
DP/CPR/85/005/11.01

POST TITLE: Chief Technical Advisor

DURATION: 2 Weeks

DATE(S) REQUIRED: May 1989

DUTY STATION: Beijing, China and travel within the country.

PURPOSE OF PROJECT:

To establish a national specialty gas research and development centre at the Beijing Specialty Gas Research Institute (BSGRI) in order to enhance the national technical capability in manufacture, analysis, storage, transportation, safe handling and use, and applications technology related to specialty gases and with particular reference to their applications in electronics, medicine, food industry and environmental protection.

DUTIES: To accomplish the purposes of the project. More specifically:

1. To review the progress and status of the project.
2. To implement the revisions to the project as agreed in the TPR of October 1988; particularly:
 - a. To assist all possible in the final preparation of data for the follow-on project document.
 - b. Assist in the placement of fellows.
 - c. Review the operation and acceptability of equipment.
 - d. Aid in the recruitment and assignment of experts.
3. Prepare a final report covering how all of the duties were accomplished.

JOB DESCRIPTION - 11.01

QUALIFICATIONS: High level scientist or engineer with extensive experience in the specialty gas industry including research and development work.

LANGUAGE: English

BACKGROUND INFORMATION:

1. The development of the Beijing Specialty Gas Research Institute is progressing very well.
2. BSGRI personnel are desirous to have the CTA continue to work with them.

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UNIDO

PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.05

- POST TITLE:** Expert in the Utilization of Gases and Gas Mixtures for Food Ripening and Food Preservation.
- DURATION:** 1 month
- DATE:** Spring 1989
- DUTY STATION:** Beijing, China
- PURPOSE:**
1. To develop techniques for the ripening and preservation of foods using various gaseous atmospheres.
 2. Establish analytical methods for measuring these gaseous atmospheres.
 3. Establish analytical (biological) techniques for measuring the adequacy of the preservation and ripening techniques.
- DUTIES:** To accomplish the purposes of the project; more specifically:
1. Complete a medium range test (preservation) for two to three vegetable species.
 2. Instruct in the techniques for producing preservation atmospheres in packages and containers.
 3. Instruct in the techniques for utilizing ethylene and other gaseous atmospheres for ripening.
 4. Deliver lectures or conduct symposia on:
 - a. Food preservation and ripening atmospheres.
 - b. The economic benefits of utilizing gaseous preservation and ripening atmospheres.

JGB DESCRIPTION - 11.05

-2-

5. Prepare a final report covering how all of the duties were accomplished.

QUALIFICATIONS: High level scientist with extensive experience in food ripening and preservation gases and atmospheres including research and development work.

LANGUAGE: English

BACKGROUND INFORMATION:

1. Food preservation and ripening gases are not used in China since the economic value of these gaseous applications has not been studied or understood.
2. The Beijing City Government has requested BSGRI to investigate the potential for preserving vegetables using industrial or other gases.
3. Overabundance and shortages of certain vegetables and other foods exists in China causing waste at certain seasons and serious food shortages at other seasons.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.09

POST TITLE: Expert in Standard and Calibration Gases.

DURATION: 14 days.

DATE REQUIRED: Spring 1989

DUTY STATION: Beijing, China

PURPOSE OF PROJECT:

To establish a National Center for the production of primary and secondary calibration gas standards.

DUTIES:

To accomplish the purpose of the project, more specifically:

1. Instruct BSGRI personnel in the method of preparation for primary gas standards.
2. Deliver lectures or conduct seminars on the analysis techniques for pure gases; and describe these techniques as they are practiced by the United States National Bureau of Standards.
3. Instruct BSGRI personnel in the proper treatment for gas cylinders used for calibration standards; and the testing methods used for determining gas mixture stability.
4. Explain the equipment and accessories necessary to produce primary standards.
5. Visit BSGRI's standards production facility and comment on the techniques used in producing these standards.

6. Prepare a final report covering how the purpose of the project was accomplished.

QUALIFICATIONS: High level scientist or engineer with extensive experience in establishment of primary gas standard centers.

LANGUAGE: English

BACKGROUND INFORMATION:

1. "National" calibration standards are required in China.
2. The National Institute of Metrology has requested that BSGRI develop these standards.

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PROJECT IN THE PEOPLES REPUBLIC OF CHINA

JOB DESCRIPTION

DP/CPR/85/005/11.11

POST TITLE: Expert in Gas Blending and Analysis.

DURATION: 21 days

DATE REQUIRED: April 1989

DUTY STATION: Beijing, China

PURPOSE OF PROJECT:

To enhance the gas blending and analysis capabilities at the Beijing Specialty Gas Research Institute.

DUTIES:

To accomplish the purpose of the project; more specifically:

1. To instruct BSGRI personnel in the specialized gas analysis techniques for determining gas purities, impurities, and mixture analyses utilizing all of the normal analytical techniques; e.g.: gas chromatography, infrared spectrophotometry, atomic absorption, ion mobility, etc.
2. Assist in the development of using a helium ionization equipped ultra-sensitive gas chromatograph for parts per billion impurity analyses.
3. Deliver lectures or conduct symposia in specialized gas blending and analysis systems.
4. Prepare a final report covering how the purpose of the project was accomplished.

QUALIFICATIONS:

High level scientist or technologist with abundant experience in specialty gas blending and analysis.

LANGUAGE: English

BACKGROUND INFORMATION:

Beijing Specialty Gas Research Institute personnel need the assistance of an international expert in gas blending and analysis.