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BURNS AND ROE ENTERPRISES, INC.

EMERGENT WORK

REPUBLIC OF ARMENIA
NATURAL GAS TRANSMISSION

SYSTEM INVESTIGATION AND EMERGENCY RESPONSE/ INSPECTION PROTOCOLS

September, 1998

Prepared by	**International Gas Consulting, Inc Houston, Texas**
Submitted to.	**U S Agency for International Development**
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A

Final Report of
Republic of Armenia
Natural Gas Transmission System
Investigation

Submitted to

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INTRODUCTION

This "Final Report of the Republic of Armenia Natural Gas Transmission System Investigation" is intended to fulfill the responsibilities of International Gas Consulting, Inc (IGC) to Burns and Roe Enterprises, Inc (BNR) covered by Contract number 5825-024 The responsibilities included preparation of a Pipeline Integrity and an Emergency Action Plan, on-site inspection of the Republic of Armenia Natural Gas Transmission System Facilities, and conducting a training seminar with key employees of Armtransgas, followed by a field exercise enacting a simulated emergency situation on the transmission system

During my visit and field tours, the activities were hampered by the death of a brother of Mr Roland M Adonts, Chairman of the Board and Executive Director of Armrusgasprom the day before I arrived, and a pipeline emergency which occurred early in my visit that required the attention of a number of the Executives of Armtransgas Due to the complete cooperation of the Burns and Roe personnel of Yerevan and of the management personnel of Armtransgas, I feel that my visit was a success despite these incidences

The Pipeline Integrity and Emergency Action Plan report is included as Part I of this document, a discussion of the meeting is included as Part II, Section A The simulated emergency is discussed in Part II, Section B

The Contract also required IGC to perform an inspection and evaluation of the gas transmission network The observations and recommendations of this inspection are included as Part III The trip report is Part IV

Attachments are included in Appendices, Part V Photographs are included in Part VI

PART I

EMERGENCY ACTION PLAN – SECTION A

SUB-SECTION A-1

EMERGENCY ACTION PROCEDURES

A **Objective** – It is essential that all employees who could be involved in an emergency be prepared to cope with the situation in an expeditious and safe manner, and that these employees are supplied with the tools, work equipment, materials, and instructions to enable them to perform those functions necessary to meet any emergency that may occur

B **Responsibility** – A qualified company, employee or authorized representative shall be responsible for the preparation of emergency plans and the emergency training of all employees so that they will be familiar with the emergency procedures Authorized field personnel shall establish and maintain liaison with fire, police, and other public officials to acquaint them with possible emergencies and ways in which they might mutually respond to such emergencies

C **Procedure**

1 **Emergency Information** – All Armtransgas locations where personnel are headquartered and all locations critical to the pipeline operation, shall have a readily available "Emergency Call List" (form AT-A-11) and a "Diagrammatic Valve Chart" Meter and Regulator Stations that have associated buildings shall have a "Meter Station Call List" posted in a prominent place The "Emergency Call List" (form AT-A-12) and "Meter Station Call List" shall include the following

a A list of whom to call in an emergency

b Names, telephone numbers and radio call numbers of the appropriate Company personnel

c Local telephone numbers of persons outside of the company who may be needed in an emergency Examples are doctors, ambulance, fire department and law enforcement officers such as sheriff or police

d At all locations where call lists are posted, the lists shall be periodically reviewed, revised, and reissued any time a change occurs

Each time an "Emergency Call List" is revised or reissued, the original list will be sent to the appropriate Linear Operating Branch, and a copy retained in the Line Service Station offices Each time a "Meter Station Call List" is revised or reissued, the original list will be posted in the appropriate M&R Station and a copy retained in the current files in the appropriate Linear Operation Branch and Line Station offices

2 **Emergency Tools, Work Equipment and Materials (Form AT-A-13)**

a **Emergency Tool Supply** – Each Transmission pipeline maintenance location shall maintain a supply of the anticipated tools and work implements which may be needed for making repairs in the event of an emergency A check list of the supply complement is to be posted at each work location at all times Any time the supply is used and also twice each year at approximately 6-month intervals, the complement shall be inspected and inventoried for comparison with the list of tools required The results of this inventory shall be reported to the Director of Linear Operation Branch

b **Emergency Work Equipment Owned by Others (Form AT-A-14)** – The use of work equipment owned by others located in the general area is often necessary or expedient to most efficiently cope with an emergency Each Linear Operation Branch or appropriate Line Service Station is to

determine what equipment is available from these sources and maintain an up-to-date Rental Rate Schedule of each contractor's equipment Once each year these listings shall be reviewed and updated

c **Determine Emergency Material Requirements** – Specific quantities of certain materials (pipe, valves, fittings, etc ,) shall be established at each location for use during an emergency which would impair the operating capability of the system These quantities of material are to be maintained at all times for this specific use only

1) **Inventory Record** – A "Materials and Supplies Activity and/or Inventory Report, listing emergency material complements for each location as well as the quantities actually on hand, shall be maintained at each location An annual check of this record shall be made at each location to insure that the emergency materials on hand satisfy the emergency complement Following each annual check, the responsible representative shall write a memo to the Director of Line or Operation Branch stating that the inspection has been made, explaining any discrepancy that exists

2) **Identification** – All emergency material, other than pipe shall be physically identified by stock number and a band of high visibility paint on the surface of each piece Emergency pipe shall be internally color-coded on each end with a band of high visibility paint Pipe that has been pre-tested shall be stenciled with the pretest pressure and identification to correlate it with the test records

3) **Re-Establishing Emergency Complements** – Each Head of Line Service Station shall periodically evaluate the adequacy of the emergency material complements within their areas of operation and revise the quantities as operating conditions dictate Written

recommendations shall be submitted to the Yerevan Office for review and appropriate action

4) **Report Distribution**

AT-A-11 - Emergency Call List

Original - Yerevann Office
Copy - Linear Operation Branch

AT-A-12 - Meter Station Call List

Original - M&R Station
Copy - Yerevan Office
Copy - Linear Operation Branch

AT-A-13 - Pipeline Emergency Tool Supply

Original - Yerevan Office
Copy - Linear Operation Branch

AT-A-14 - Emergency Work Equipment Owned by Others

Original - Yerevan Office
Copy - Linear Operation Branch

Memo –"Establishing Emergency Complement"

Original - Yerevan Office
Copy - Linear Operation Branch

3 Emergency Action Guidelines

a **Outline of Emergency Action** – Even with highly skilled and conscientious operators, emergencies still occur It is the duty of each employee to be able to recognize and to be prepared to take the proper action when an emergency exists

Some emergencies require immediate action Others may require evaluation prior to implementing a plan of action Good judgement applied in each situation will indicate the appropriate action necessary Emergency Action

Training Sessions provide assurance that employees are familiar with Emergency Action Procedures and help to insure that sound judgement is exercised

1) **Define the Emergency** – There are many types and degrees of emergencies Any abnormal operating problem is an emergency to some degree as is any action or event that endangers or threatens to endanger pipeline facilities, the pipeline operation, and public or employee safety In any major emergency, **public safety is first priority** Some examples of emergencies are pipeline rupture, a major leak, compressor station explosion, hydrate formation, a fire, flood, hurricane and customer facility or equipment failure

2) **Recognize the Emergency** – First notification of an emergency or problem may come from employees, customer or supply companies, law enforcement agencies or from the general public It is possible that a supervisor may be the first to recognize that an emergency exists

3) **Take Immediate Action** – The judgement factor, job knowledge, familiarity with the pipeline facilities, and good common sense, must be used in determining the first actions required Such action may avert a major emergency The use of a hand-held fire extinguisher, the closing of a valve, the stopping of an engine, are examples of immediate action that may avert a major emergency

   Immediately notify the Dispatch Center and the Supervisors of the affected areas If possible, location and extent of trouble should be included Even if unsure that the situation should be classified as an emergency, **REPORT IT** It may be more serious than apparent

   Notify local fire, police, and other public officials as the situation requires

4) **Emergency-Condition Operating Limitations** – During emergency situations at a compressor station or on the pipeline, which could affect gas throughput, supervisory operating personnel must take whatever action is necessary to protect the station or pipeline as soon as possible This judgement can only be made based on the facts known by the operators at the time However, as a general rule, the nearest operating upstream compressor station adjacent to a pipeline rupture should be shut down and block valves on each side of the rupture should be closed An ESD system or automatic valve operators may perform these functions if properly installed and operable The Dispatch Center should be immediately notified of the conditions, after which the Dispatch Center will immediately establish a log of events for the duration of the incident The Dispatch Center will advise when valves are to be opened and the station or pipeline returned to service

5) **Know What Others Will Do** – It will be the responsibility of the Dispatch Center to notify the appropriate department employees at other locations that may be affected by the emergency and to alert all necessary pipeline control locations During an emergency, as during normal operations, the Dispatch Center will issue all orders affecting the flow of gas in the pipeline As part of the coordinated control, they will be guided by counsel with the appropriate departments

   At the emergency location, supervisors will establish a Field Operations Center and will coordinate the movement of personnel, materials, and equipment As soon as the emergency permits, the Operations Center shall counsel with their department headquarters as well as affected operating locations

6) **Reporting** – Effective communication and accurate reporting are two of the most important elements in any continuing emergency and must be

given special consideration Supervisors will insure that effective and adequate communications are provided by

a Establishing a chain-of-communication from the emergency site to the Field Operations Center, thence to the Dispatch Center

b Equipping the Field Operations Center with qualified operators so that accurate information will be transmitted to and received from the Dispatch Center

c Using whatever communication methods available, such as mobile VHF, relay units, or maintaining open commercial landlines

The supervisor-in-charge or a designated assistant will originate all reports A qualified messenger may be used to transmit information Reports will be made often during the early action As the activity progresses, the frequency of reporting as established by the Dispatch Center will be followed by the Field Operations Center As the work progresses, estimates of the completion time will be revised as necessary

7) **Make Specific Job Assignments** – Each Emergency Plan should include specific job assignments so that when an emergency exists, the supervisor is able to coordinate the activities of the employees to obtain maximum effectiveness regardless of normally assigned duties

8) **Be Prepared** – Each work unit supervisor has the responsibility of ensuring that all personnel are prepared for emergencies Methods that may be used in emergency preparation are, Scheduled Training meetings, Emergency Action Plan review sessions and maintaining emergency tools, equipment and materials in a ready state Other methods, such as the use of hypothetical or simulated emergencies to test preparedness, the use of films, charts, models, and other visual aids, are encouraged It is

important that all personnel understand that it is their responsibility to be prepared in the event that an emergency occurs

9) **Restore Service** – Following an actual emergency, precautions must be exercised in safely restoring service to avoid creating another emergency Planning and coordination are just as important during this phase as during the emergency itself Of particular importance is coordination with the Dispatch Center on valve positioning to assure that the system is efficiently restored

10) **Public Relations** – During emergencies, Company interests are vitally affected and relations with property owners, the general public, and news media representatives are especially important Policies and procedures established by Armtransgas officials shall be strictly complied with

4 **Emergency Action Plans** – Each Head of Line Service Station will develop basic written plans of action in outline form for possible emergencies in typical situations, following the guidelines in Sub-section 3 above entitled "Emergency Action Guidelines" The plans will be kept up-to-date as operation or facility changes occur and will be reviewed annually at approximately 12-month intervals A memo will be forwarded from each Head of Line Service Station to the appropriate Director of Linear Operation Branch documenting the Emergency Action Plan review The plans will include placement or movement of equipment and personnel, location and operation of key valves, operation of area meter and regulator stations and regulator settings, establishment of communication systems, notification of coordination of action with public officials, and any other necessary action needed to cope with an emergency situation

Some examples of possible emergencies for which action plans shall be prepared are Pipeline rupture or major leak in a multiple line system, incidents in a single line system, compressor station explosion, M&R station fire or emergency,

hydrate formation, fire, flood, hurricane, loss of service to a customer, major oil spill at a compressor station or from a pipeline, etc

Each Emergency Action Plan shall be appropriately titled for reference purposes and kept readily available at each work unit location Transmission operating locations will send the original plan to the Yerevan Office and retain an area location copy

5 **Coordination with Public officials** – Each Head of Line Service Station shall periodically contact appropriate local public officials to acquaint them with the location of pipeline facilities in their areas and to provide current Emergency Call information, to exchange emergency information and capabilities, and to review mutual response plans Each Head of Line Service Station will maintain Armtransgas telephone numbers in local telephone directories in areas traversed by Armtransgas pipelines Periodically, landowners abutting Armtransgas pipelines shall be contacted to review emergency notification procedures

Local utility companies, excavating contractors, Government Engineering Departments, and other related engineering firms shall be contacted periodically to acquaint them with the location of Armtransgas facilities and to provide them with names of local supervisors to contact before starting any construction near Armtransgas facilities The schedule for contacting the above-listed local officials and excavating firms will be as follows

a **Personal Contact** – Personal contact shall be made in January each year to present Emergency Call information and to renew acquaintances and establish contact with many public officials assuming office for the first time The information shall contain day and night emergency telephone numbers Discussions shall include a review of pipeline emergency practices

b **Mail-Out Contact** – Mail-out information which shall include "Excavation Caution Notices", as well as day and night emergency telephone numbers, shall be mailed to the appropriate local officials, utility companies and

excavation contractors The "Excavation Caution Notices" and associated information may be personally delivered as appropriate for greater effectiveness

c **Reporting** – Once each year, following the personal contact phase, each Head of Line Service Station will be responsible for submitting to their respective Head of Division, a composite report listing all contacts made either in person or by mail The report shall list public officials and firms separated by geographical areas such as County, Parish Township, etc , as appropriate The type contact and the specific handouts delivered or mailed shall be listed by each entry

6 **Emergency Action Training** – Each location, where Armtransgas personnel are headquartered, will conduct Emergency Action Training meetings each year at approximately 6-month intervals The meetings will be used to acquaint all personnel with the local Emergency Action Plans which have been prepared by the supervisors in accordance with the "Emergency Action Guidelines"

a **Presentation** – The Emergency Action training meetings should be conducted in such a manner as to be thought-provoking and to test for the employee's preparedness Every effort to assure that the training is effective shall be utilized If possible, utilize a variation from the Emergency Action Plan, including Oil Spill Contingency Plans, and other aids each time to avoid repetition Direct questioning of personnel will aid greatly in evaluating training effectiveness

b **Reporting** – The Emergency Action training meetings are to be recorded and the Roster and Minutes of Meetings distributed

Report Distribution

Emergency Action Plan and Annual Review Memorandum

Original	-	Yerevan Office
Copy	-	Linear Operation Branch

Report of Contact with Public Officials

Original	-	Yerevan Office
Copy	-	Linear Operation Branch

Memo – Minutes and Roster of Meeting

Original	-	Yerevan Office
Copy	-	Safety – Department
Copy	-	Linear Operation Branch

EMERGENCY ACTION PLAN – SECTION A

SUB-SECTION A-2

INVESTIGATION OF
MAJOR PIPELINE SYSTEM EMERGENCIES

A **Objective** – In the event of a major pipeline emergency such as a line rupture or compressor station or meter station fire, it should be Armtransgas' policy to conduct an in-depth investigation of the incident to determine the extent of damage to Armtransgas and other parties, to identify the cause of the incident, to identify all of the events and other facts associated with the occurrence, and to establish recommendations and conclusions concerning the occurrence which could help avoid similar future incidents Following is a general procedure setting the guidelines for the investigation and indicating the responsible employees It is recognized that the wide variety of potential emergencies does not allow detailed guidelines for all emergencies, but rather, the responsible employee must determine the details to be investigated

B **Responsibility**

1 The Director of Operations is responsible for seeing that a written report of each major pipeline system emergency is prepared in accordance with Company and Governmental requirements by someone designated by the Director of Operations The report should be circulated to Heads of all departments affected by the particular emergency The original should be filed in the Director of Linear Operation Branch Pipeline System leak files If the Director deems it necessary, the appropriate department head or other qualified representatives shall be dispatched to coordinate the on-scene investigation

2 The Armtransgas supervisor who is in charge at the scene is responsible for gathering and maintaining any and all information that could be useful in an emergency incident investigation It is important that detailed written records

of events and times be kept, photographs be taken of all items of interest, witnesses' names and addresses be obtained, contacts with police, local and state government officials and other significant information be recorded

C **Investigation Guidelines** – The following guidelines are to be considered minimum requirements For organization purposes, they are listed under the basic purposes of the investigation as noted above

1 Determine the extent of damage to facilities owned by Armtransgas and others

a Photographs of any and all damage

b Cost estimates of all damage to Armtransgas and the public, should be made

c Detailed description of injury to Armtransgas employees or the public

2 Put together a detailed chronological sequence of all events related in any way to the emergency

a Pertinent events leading up to the emergency incident should be included

b Description of the incident should be obtained from all persons who observed it, if possible, and it is best if the persons submit a written description

c The incident, events prior to and after the incident, as well as the exact (or best estimate of) time should be determined and recorded

3 Identify the cause of the incident

a A detailed explanation of the process used to determine the cause of the incident is required

b If it is determined by the Director of Operations and Administrative Assistants that an outside consultant is required to help determine the cause, the consultant should be obtained as quickly as possible A

coordinator for this work should be designated and copies of the formal report should be included in the investigation report

4 Establish conclusions and recommendations concerning the incident Any recommended action should indicate the party responsible for implementing such action

D Reporting

1 A comprehensive written report will be prepared and distributed by persons designated by the Director of Operations in compliance with Paragraph 1 of Sub-section B

EMERGENCY ACTION PLAN – SECTION A

SUB-SECTION A-3

FIELD REPORTING OF LEAKS, ACCIDENTS, FAILURES, AND INTERRUPTION OF SERVICE ON THE PIPELINE SYSTEM

A **Objective** – The objective of this section is to outline the procedures to be followed by field employees in reporting accidents, failures, interruptions of service or other emergency information to the appropriate administrative office It is also the objective of this section to inform all employees of their responsibility for collecting the necessary data and to whom this data is to be reported

B **Responsibility** – It will be the responsibility of the field employees who discover an accident, failure, leak, interruption of service, or other emergency condition to report the incident to the Dispatch Center and to other appropriate parties on the Emergency Call List as prescribed in Emergency Action, Sub-Section A-1 The Dispatch Center will notify all other appropriate departments It is the responsibility of the affected Director of Linear Operation Branch, or an assigned representative, to submit a written report of incidents to the Director of Operations **within seven (7) days of the occurrence,** giving all available information It is the responsibility of the Director of Operations to determine whether an incident report should be submitted to any regulatory commission

C **Procedure**

1 **Reports to Director of Operations or Designated Representative**

Incidents requiring reports - An immediate report must be made to the Dispatch Center and the Director of Operations by telephone any time an accident, failure, leak or other incident occurs, or threatens to occur, and meets any of the following conditions

a That could result in the interruption of service to a customer

b That interferes with the manual operation of a pipeline facility or equipment

c That results in removing a transmission pipeline segment from service

d That causes death or personal injury requiring hospitalization of a person

e That results in a fire, regardless of the origin

f That causes an estimated $50,000 property damage to the Company and/or to others

g That is significant in the judgement of the supervisor even though it did not meet the criteria above

2 Information Necessary to Report

The field personnel reporting any incident to the Dispatch Center or others should give brief and concise reports The reports should include the following information

a Location and time of incident

b Nature of incident

c Emergency action taken

d Extent of damages, including deaths or injuries, if any

e Name of person reporting and when additional reports can be obtained

f All other significant facts known initially that are relevant to the incident

g The person reporting from the field should keep a log of all information reported in accordance with a through f in this section and note who in the Dispatch Center received the report

D Reporting

1 Incidents Requiring Reports

All incidents requiring telephone notification to the Director of Operations will require a written report **within 7 days of the occurrence** Written reports are requested of all significant incidents, even though notification to a Governmental Regulatory Agency is not required

2 Information Necessary to Report

The written report shall be directed to the Director of Operations All significant information pertaining to the incident, including the results of any field investigation and remedial action recommendations shall be included

3 Type of Report

a Completion of an appropriate Pipeline Inspection Report form (AT-A-15) or a Memo providing all pertinent information will normally suffice as a written report However, other available significant information, including the results of any field investigations or remedial action recommendations, should also be submitted, in memo form, to the Director of Linear Operation Branch, with a copy to the Director of Operations

b A Leak, Damage, or Test Failure Report (AT-A-16) is required for all test failures and leaks even though these incidents are not reported to a Government Regulatory Agency

Report Distribution

AT-A-15 - Pipeline Inspection Report

Original	-	Yerevan Office
Copy	-	Corrosion Control
Copy	-	Linear Operation Branch
Copy	-	Attach AT-A-16 to all copies In Event of a Leak

AT-A-16 – Leak, Damage, or Test Failure

Original	-	Director of Operations
Copy	-	Yerevan Office
Copy	-	Dispatch Center
Copy	-	Technical Services
Copy	-	Corrosion Control
Copy	-	Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-1

PIPELINE PATROLS AND LEAK SURVEY INSPECTIONS

A **Objective** – To establish a procedure for observing surface conditions on and adjacent to the right-of-way which could affect pipeline safety and operation

B **Responsibility** – The selection of qualified employees to perform and document the inspections and overall administration of the pipeline and right-of-way patrol schedule, including follow-up and corrective action initiation is the responsibility of the Head of Line Service Station

C **Procedure**

1 **Patrols and Inspections**

a **Scope of Pipeline Patrols & Inspections**

A patrol will be made of the entire pipeline right-of-way of all mainlines, sales laterals and purchase laterals at a frequency that will satisfy the minimum schedule as listed in Paragraph C 1 b of this section It is essential to have credible documentation of all pipeline inspections Therefore, specific notes will be made on the appropriate forms as to the condition of all spans, river crossings, road crossings, railroad crossings, right-of-way erosion, signs, range lights, general condition of the right-of-way and construction or other activities that may require remedial action or additional attention All identifiable problem areas will be referenced to Mile Post numbers

b **Frequency of Pipeline Patrols**

1) **Class 1 & 2 Areas** – All highway and railroad crossings will be patrolled and inspected at least 2 times each calendar year with a time period between patrols not to exceed 7½ months All other right-of-ways will be patrolled and inspected at least one time each calendar year with a time period between patrols not to exceed 15 months

2) **Class 3 Areas** – All highway and railroad crossings will be patrolled and inspected at least 4 times each calendar year with a time period between patrols not to exceed 4½ months All other rights-of-way will be patrolled and inspected at least 2 times each year with a time period between patrols not to exceed 7½ months

3) **Class 4 Areas** – All pipeline right-of-ways, including highway and railroad crossings, will be patrolled and inspected at least 4 times per year with a time period between patrols not to exceed 4½ months

4) **Class Location Definitions (Population Density)**

Class 1 – Any class location unit with 10 or less buildings intended for human occupancy [**A class location unit** is an area extending 220 yds (201 m) on either side of the centerline of any continuous 1-mile (1 61 km) length of pipeline]

Class 2 – Any class location unit that has more than 10 but less than 46 buildings intended for human occupancy

Class 3 – Any class location unit that has 46 or more buildings intended for human occupancy, or an area where the pipeline lies within 100 yds (91 4 m) of either a building or a small, well defined outside area (such as

a playground, recreation area, outdoor theater or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period

Class 4 – Any class location unit where buildings with four or more stories above ground are prevalent

2 **Leak Surveys**

a **Scope of Leak Surveys** A leak survey will be made of all Armtransgas pipeline facilities, including measuring and regulating stations, at a frequency that will satisfy the minimum schedule as listed in Paragraph C 2 b of this Sub-section During these surveys, specific notes will be made on the appropriate form of all observations that may indicate a leak such as, dead or discolored vegetation, gas bubbles in moisture-saturated soils and at underwater pipeline crossings, odors, dust, unusual noise along the pipeline or at casing vent pipes, and any other indications of a gas leak Leak detection equipment should be used

b **Frequency of Leak Surveys**

1) Class 1 & 2 Areas All mainlines, purchase laterals, and sales laterals will be surveyed at least one (1) time each calendar year with a time period between surveys not to exceed fifteen (15) months

2) Class 3 & 4 Areas When gas is odorized All main lines purchase laterals and sale laterals will be surveyed at least one (1) time each calendar year with a time period between surveys not to exceed fifteen (15) months

3) Class 3 Areas Where gas is not odorized All main lines, purchase laterals and sale laterals will be surveyed, utilizing leak detection equipment, at least two (2) times each calendar year with a time period between surveys not to exceed seven and one-half (7½) months

4) Class 4 Areas Where gas is not odorized All main lines, purchase laterals and sale laterals will be surveyed, utilizing gas detection equipment at least four (4) times each calendar year with a time period between surveys not to exceed four and one-half (4½) months

3 **Other Pipeline Patrols**

a **Specialized Land Patrols** In congested areas or areas of abnormal construction activity, it will be necessary to establish a more frequent patrol schedule for the monitoring of the pipeline facilities Due to the many variable conditions, the need and performance of these specialized patrols

becomes a matter of judgement, which is to be evaluated by all field supervisory personnel

4 **Reporting** The conditions observed during these patrols and leak surveys will be reported on the Pipeline Patrol and Leak Survey Report (form AT-B-21) If a leak or other incident of an emergency nature is detected, an immediate telephone report will be made to the appropriate Department Supervisor and to the Dispatch Center

Report Distribution

AT-B-21 - Pipeline Patrol and Leak Survey Report

Original	-	Yerevan Office
Copy	-	Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-2

IDENTIFICATION OF FACILITIES

A **Objective** – To make the general public aware of the existence and ownership of facilities in order that these facilities may be respected and protected from damage by others

B **Responsibility** – Each Head of Line Service Station is responsible for the proper installation, inspection, and maintenance of markers and signs within the Line Service Station area of operation

C **Procedure**

1 **Identification of Pipe Lines**

a **Pipeline Markers** – Install (over each pipeline) at all highway and railroad crossings and in certain populated areas where the prominent marking of the pipeline is necessary for safety These markers are to be maintained free of dirt and growth of weeds, and are to be legible at all times

b **Casing Vent Cap** – Install vent caps on all casing vents on main and lateral pipelines The company telephone number listed on these caps will be as specified by the Director of Operations Casing vent caps are not classified as pipeline Markers

c **Construction Markers** – Prior to new construction adjacent to existing facilities, the centerline of the existing pipeline will be marked with temporary construction signs on approximately 200 foot (61m) centers In some cases, temporary barricades may be required for protection of above-ground facilities

d **Identification of Pipelines at Intersections of Utility Crossings** – Pipeline markers will be erected at intersections of overhead and buried utilities where exposure to company facilities warrants such installation to reduce the possibility of damage or interference

e **Identification of Submerged Crossings** – Signs will be erected, inspected, and maintained at all submerged crossings of intercoastal canals and navigable streams where navigation and/or marine activity could interfere with the pipeline Range lights, where installed, will be inspected and maintained for proper operation

f **Pipelines Above Ground** – Pipeline markers will be installed at each section of line located above ground that is accessible to the public, such as spans and aerial crossings of streams

2 **Identification of Right-of-Way**

Fence Posts across Right-of-Way – At road crossings the two (2) outside fence posts marking limits of right-of-way will be painted In fields and wooded areas, a painted post will be placed over each pipeline on multiline systems In the case of single pipelines, both the right-of-way limits and the post over the pipeline will

be painted A high visibility paint is standard for marking right-of-way limits and posts marking a pipeline Exceptions to this requirement may be made where landowners object

3 **Identification of Above-ground Structures**

a **M&R and Dehydration Equipment** – On each fence gate, install one "No Admittance" and one "No Smoking" sign On each meter station door, install one "No Smoking" sign At a prominent place on the dehydration structure, install one "No Smoking" sign On the fence to the right of main gate, install one standard emergency notification sign with company emblem and appropriate telephone numbers [Standard sign sizes are normally approximately 20" (51 cm) by 12" (30 5 cm)]

b **Fenced Main Line Valves** – On each fence gate install one "No Admittance" and one "No Smoking" sign On the fence to the right of the main gate, install one, standard emergency notification sign with company emblem containing appropriate telephone numbers

c **Compression Stations** – On each drive-through gate install one standard emergency notification sign with company emblem On each walk gate install one "No Admittance – Apply at Office" sign and to the right of each walk gate install one standard emergency notification sign with company emblem containing appropriate telephone numbers

D **Reporting -** As part of the Annual Land Patrol, all signs and markers will be inspected and any needed repairs or replacements will be reported on Pipeline Patrol and Leak Survey Report (form AT-B-21)

Report Distribution

AT-B-21 - Pipeline Patrol and Leak Survey Report

Original	-	Yerevan Office
Copy	-	Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY SECTION B

SUB-SECTION B-3

HIGH PRESSURE GAS VALVES

A **Objective** – The objective of this inspection is to ensure safe and reliable operation of valves including automatic shutdown equipment that might be required during an emergency and during the course of normal operations

B **Responsibility**

1 **Head of Line Service Station** – Main line valves, including related blowoff valves, lateral line valves, river crossing valves, all process plants and compressor station valves including sidegates, single and double block valves, meter station tap valves, meter station numbered valves, crossover valves, main line valve regulators, and automatic valve operators will be inspected and maintained by personnel of the Department

2 **Measurement Personnel** – Valves inside meter station yards, and dehydration plants, but not including other valves for which the Head of Line Service Station is responsible, will be inspected by Measurement personnel Any abnormal conditions will be reported to the Head of Line Service Station, who will be responsible for service and maintenance Measurement personnel will assist with inspection and service of main line regulators if requested

C **Procedure**

1 **Dispatch Center Approval** – Approval will be obtained from the Dispatch Center prior to the operation of any valve or testing and operation of any automatic operator that affects the flow of gas, except during an emergency

2 **Valve Inspections** – At least once each calendar year at intervals not exceeding 15 calendar months, valves will be inspected and, where feasible, will be

operated through a full cycle and returned to their original position Automatic trip devices on main line block and crossover valves will be tested in conjunction with this inspection Where it is not feasible to fully operate valves, such as single line or meter station tap valves, blow off valves, etc , these will be inspected and partially operated to verify the valves' operation Each time a valve is operated the valve shall be lubricated in accordance with recommendations of the valve manufacturer

Exception – Single valve compressor station block valves will not be operated for the purpose of inspection However, whenever this valve is operated through the normal course of operation, it will be so noted on the report form (AT-B-22)

C Reporting

1 All valve and valve operator inspections, including the amount of lubricant used for each valve, will be recorded on the Valve Inspection Report form A record of the two previous inspections will be retained on file

Report Distribution

AT-B-22 - Valve Inspection Report

Original	-	Yerevan Office
Copy	-	Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-4

PRESSURE LIMITING DEVICES AND RELIEF VALVES

A **Objective** – The objective of this procedure is to ensure that all high pressure shutdown devices and relief valves will perform properly in the event of equipment or system malfunction The primary protection device for compressors and station yard piping will be the high pressure shutdown device The relief valves will serve as backup protection in compressor station piping and as primary protection in meter stations

B **Responsibility** – The testing, inspection and maintenance of high pressure shutdown and relief valves for specified locations shall be performed by Transmission personnel as defined below

1 **Transmission Line Service Station Personnel** – All high and low pressure shutdown devices and high gas pressure relief valves located on the pipeline or at transmission compressor stations, process plants, dehydration and separation plants, gas storage fields, and M&R facilities

2 **Measurement Personnel** – All relief valves and high and low pressure shutdown devices located in meter and regulator stations except compressor station and process plant fuel gas

C **Procedure** – High pressure shutdown devices and gas pressure relief valves are primary overpressure protection devices and they will be inspected, maintained and tested at intervals not exceeding fifteen (15) months, but at least once each calendar year The test will be conducted with the valve in place, when possible, using a non-methane pressure source The relieving pressure will be adjusted by the manufacturer's recommended procedure Each relief valve must relieve at a pressure designated by Technical Services for that particular segment The test date and

initials of the person performing the test are to be noted on a legible decal and affixed to the relief valve body

In addition to the relief pressure and reseat testing, the valves will be checked for the following

1 **Capacity** – The relief valves will be tested to determine if they have sufficient capacity to limit the pressure on the facilities to which they are connected to the desired maximum pressure If such tests are not feasible, calculations will be made to determine the relief valve's capacity The calculated capacity must be adequate to limit the pressure on the facilities to the desired maximum pressure The calculations are to be shown for each capacity check

2. Mechanical condition

3 Properly installed and protected from dirt, liquids or other conditions that might prevent proper operation

4 Thermal relief valves will not require a capacity check

D **Reporting** – All relief valve tests and inspections shall be recorded on the Relief Valve Inspection Report (form AT-B-23)

Report Distribution

AT-B-23 - Relief Valve Inspection

Original	-	Yerevan Office
Copy	-	Linear Operation Branch
Copy	-	Witness

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-5

PRESSURE AND TEMPERATURE MEASURING EQUIPMENT

A **Objective** – To insure the safe, accurate and dependable operation of all pressure and temperature indicating and recording instrument

B **Responsibility**

1 The Head of Line Service Station is responsible for maintaining the integrity of temperature monitoring devices and for preparing reports of all tests and calibrations

C **Procedure**

1 Twice each year or whenever there is an indication that these instruments are not functioning properly, an immediate inspection will be made and any deficiencies corrected The test date and initials of the person performing the test are to be noted on a legible decal and affixed to the instrument case

D **Reporting**

Tests and inspections made and record of calibration or repair will be recorded on "Inspection Report – Temperature and Pressure Instruments", (form AT-B-24)

Report Distribution

AT-B-24 – Inspection Report – Temperature & Pressure Instruments

Original - Yerevan Office
Copy - Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-6

PIPELINE PIGGING

A **Objective** – To remove liquids, rust scale and other impurities from the interior of the pipeline, which will result in improved through-put efficiencies and a corrosion-free environment Defects that may affect the integrity of the pipeline may be detected by Instrumented In-line devices (Smart Pigs)

B **Responsibility** – The appropriate Director of Linear Operation Branch is responsible for determining pigging frequency and the implementation and supervision of this procedure

C **Procedure**

1 Pipelines that are equipped with pig launchers and receivers, and are piggable should be pigged at a minimum interval of twice a year Additional pigging, due to unusual operating conditions, should be performed at the discretion of the Director of Linear Operation Branch Defect detection (Smart Pig) inspections shall be performed as operating conditions dictate

Note IGC realizes that no pig launchers and receivers are currently installed on the Armtransgas Natural Gas Transmission System and that operating conditions prohibit implementation of this procedure at this time

2 Benefits to be gained from conventional type pipeline pigging

a Remove liquids from pipeline, thereby reducing the potential for internal corrosion

b Remove rust scale and other solids and/or impurities from the pipeline interior

c Deliver cleaner gas, thereby eliminating deposits of foreign materials on orifice plates

d Reduced abrasion and erosion damage to interior of valves, pressure regulators, and other pipeline facilities during periods of high velocity gas flow

e Reduce coefficient of friction which results in minimizing the pressure drop in the pipeline and improving through-put

3) Benefits to be gained from instrumented inspection devices (Smart Pigs)

a Provide a recorded log of location and severity of pipeline defects such as

1) Corrosion pitting, general corrosion, erosion, and/or other losses of metal thickness

2) Mechanical damage, gouges, dents, etc

3) Plate or pipeline manufacturing defects and imperfections such as roll-in slugs, inclusions, laminations, and slivers

4) Hard spots, hydrogen blistering, and circumferential cracking

b Provide recorded log of pipeline appurtenances useful in accurately locating identified defects, such as

1) Welds, (girth, spiral, and repair)

2) Valves, fittings, side taps, and transition joints

3) Casings, clamps, and sleeves

D Reporting

1 Data reflecting the pig type, pigging pressure, run number, date, beginning and ending times of each pig run, and the quantity of liquids and solids removed from the pipeline, along with other pertinent remarks, shall be recorded on Report of Pigging Operations form AT-B-25 and appropriate supplemental reports, and retained in the respective Yerevan Offices and at the Linear Operation Branch

Report Distribution

AT-B-25 - Report of Pigging Operations

Original - Yerevan Office
Copy - Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION SECTION B-7

CORROSION CONTROL PROGRAM

A **Objective** – To establish procedures for the implementation of an effective Corrosion Control Program designed to ensure the integrity of the underground and aboveground pipeline facilities

B **Responsibility** – The Head Engineer – Corrosion Control – is responsible for establishing a Corrosion Control Program and providing policy, technical assistance, specifications, and standards relative to the effective operation and maintenance of the program The Director of the Linear Operation Branch is responsible for the administration and implementation of the Corrosion Control Program via the pipeline corrosion control methods These responsibilities include the design, installation, operation and maintenance of cathodic protection systems on all pipeline facilities and inspection of aboveground and underground pipeline coating systems

C **Procedures**

1 Atmospheric corrosion protection on aboveground pipeline facilities will be achieved through the use of appropriate protective coatings Following the initial inspection and repairs, re-evaluation inspection intervals shall not exceed three years on the following facilities

a Pipeline valves

b Compressor station and miscellaneous plant facilities

c Measuring, regulating, and interchange facilities

d Pipe spans

e Suspension bridges

f Emergency and stock pipe and materials

The inspections shall be performed for evaluation of the ground level and aboveground protective coatings, grouts and/or sealant, and emergency and stock material preservatives, as well as any loss in material thickness due to corrosion or outside forces paying particular attention to condition at ground level

Results and recommendations shall be submitted in a letter type report

2 Underground – Corrosion protection of underground pipeline facilities shall be achieved by the use of protective coating systems, supplemented by cathodic protection derived from rectifiers and associated groundbeds, galvanic anodes, drainage from direct current sources or by combinations of the above Cathodic protection shall be installed and placed in operation on all underground pipeline facilities

a Bi-monthly Inspections shall be performed on Corrosion Control facilities to assure continued operation of the rectifiers and associated anodes The operating voltage, current output, and pipe-to-soil potential for each pipeline at each rectifier location shall be observed and recorded

b Annual Inspections of Corrosion Control facilities shall be performed each year at intervals not exceeding 15 months and the following information recorded

1) Rectifier operation voltage and total current output

2) Pipe-to-soil potentials for each pipeline rectifier location

3) Pipe-to-soil potentials at representative test points throughout the pipeline system to insure that cathodic protection is adequate

4) Pipe-to-soil potentials and magnitude and direction of current flow at each stray current drain switch, interference bond, and galvanic anode installation

5) Pipe-to-soil potentials at all line valves and tap valves

6) The effectiveness of each isolating flange

c **Criterion for Cathodic Protection**

The primary criterion for cathodic protection of the exterior of underground facilities shall be a cathodic structure voltage of at least 0 85 volts negative to earth with respect to a saturated copper-copper sulfate reference electrode as determined with the protective current applied However, if the primary criterion cannot be obtained, then one or more criterion as set out in NACE International Standard RP0169-(latest revision) may be used

D **Reporting** – Reports shall be prepared and distributed as follows

1 **Bimonthly Inspection Report** – Corrosion Control inspection reports (Cathodic Protection Report form AT-B-26) shall be prepared and filed in the Yerevan and appropriate Linear Operation Branch Office Potentials below criterion shall be explained and proposed remedial action noted in the reports

2 **Annual Inspection Report** - Each calendar year, rectifier operating data and pipe-to-soil potential and current distribution surveys shall be compiled and a report (form AT-B-26) prepared and filed in the Yerevan and the appropriate Linear Operation Branch Office Potentials below criterion shall be explained and proposed remedial action noted in the following reports

Report Distribution

AT-B-26 - Cathodic Protection Report

Original	-	Corrosion Control Coordinator
Copy	-	Yerevan Office
Copy	-	Linear Operation Branch

TRANSMISSION PIPELINE INTEGRITY – SECTION B

SUB-SECTION B-8

PIPE AND COATING CONDITIONS

A **Objective** – To inspect and report the pipe and coating conditions during the course of normal pipeline operations

B **Responsibility** – The respective Director of Linear Operation Branch via the Head of Line Service Station is responsible for the implementation of this procedure

C **Procedure**

1 **Exposed Pipeline** – When an underground pipeline facility is exposed, the Supervisor or Inspector on the job site shall observe the condition of the pipe and coating and a Pipeline Inspection Report (form AT-A-15) shall be prepared and submitted If the exposed area reveals any corrosion, defect, or damage to pipe or coating, Corrosion Control personnel shall be notified

2 **Internal Pipe Surfaces** – When a pipeline is scheduled to be cut, the Supervisor or Inspector on the job shall inspect the interior surface of the pipe for coating conditions, if internally coated, and if evidence of corrosion, or a heavy build-up of scale is observed, Control personnel shall be notified Observations shall be reported on a Pipeline Inspection Report (AT-A-15)

3 **Operating Facilities Removed from Service** – When an operating facility (Valve, Pipeline, Meter Station) is removed from service, the Supervisor or Inspector shall inspect the facility for coating conditions and for evidence of corrosion A report of the inspection, including observed conditions, shall be prepared by the Corrosion Control Coordinator and shall be placed on file in the Yerevan Office with copies to the appropriate Linear Operation Branch and Line Service Stations

4 **Protective Coatings** - Underground coatings when found to be defective shall be repaired in accordance to Armtransgas Painting and Coating procedures Precautions shall be taken to minimize damage during backfilling operations

Report Distribution:

AT-A-15 - Pipeline Inspection Report

Original	-	Yerevan Office
Copy	-	Line Service Station
Copy	-	Corrosion Control Coordinator
Copy	-	Linear Operation Branch

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AT A-11

Emergency Call List

Name	City	Phone No	VHF Radio	Pager No	Car Phone
		Night:			
		Day:			
		Night:			
		Day:			
		Night:			
		Day:			

Company Personnel Directory

Name	City	Phone No	VHF Radio	Pager No	Car Phone

Other Emergency Contact Information

	Name	Location	Phone No
Company Doctor			
Ambulance			
Hospital			
Fire Department			
Police or Sheriff's Department			
Other Emergency Nos			

Distribution Original – Yerevan Office Copy – Linear Operation Branch

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AT-A 12

Meter Station Call List

Meter Station Name _____ Location Address	Station No	I D No

Emergency Calls in the Preference Listed Below

	Name Address. Phone	Office Phone	Home Phone
	Name _____ Address		
	Name _____ Address		
	Name _____ Address		

Routine Operation Calls by Customers Contract Personnel and Others

Daily Dispatch Data Calls		Office Phone	Home Phone
	Name _____ Address.		
	Name _____ Address:		
Producer or Customer Company	Name. _____ Address:		
	Name: _____ Address:		

Local Emergency Numbers		Office Phone
Doctor	Name _____ Address:	
Ambulance	Name: _____ Address:	
Fire	Name. _____ Address:	
Police	Name: _____ Address:	

The Information Above Was Reviewed and Found Correct on the Date Indicated Below

Month	Date	Initials	Month	Date	Initials	Month	Date	Initials
January			January			January		
February			February			February		
March			March			March		
April			April			April		
May			May			May		
June			June			June		
July			July			July		
August			August			August		
September			September			September		
October			October			October		
November			November			November		
December			December			December		

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AT A 13

Pipeline Emergency Equipment Inspection Report

Location

Quantity	Description Of Equipment	Condition (Good Fair etc)	Date Inspected	Remarks *(Specify Any Locations Other Than That Shown Above)*	Inspected By

If any item is in subnormal condition explain in Remarks space

Distribution Original – Yerevan Office
Copy – Linear Operation Branch

Approved By _____ Date _____

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AT A 14

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Emergency Work Equipment Owned by Others

Company Address	Day Phone Night Phone	Personnel to Contact	Equipment Location	Date

Equipment			Remarks
Type	Make	Size	

AT-A-15
Front

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Pipeline Inspection Report

Inspection Date _____

Exposed Pipeline Inspection Report When an underground pipeline facility is exposed the Supervisor or Inspector on the job site shall inspect for coating conditions and a Pipeline Report shall be prepared and submitted. If the exposed area reveals any corrosion defect, or damage Corrosion personnel shall be notified

Reason for Inspection _____

(1) Location

Division _____ Area Sta or Dist. _____ State _____ County _____

Beg Sta No _____ End Sta No _____ Line _____ Location Code _____

Beg M P _____ End M P _____ Align Sheet _____

Valve Sec ion _____ to _____

(2) Piping

Pipe Size _____ Spec. W T _____ Actual W T _____

(3) External Pipe Coating

A Coating	B Application	C Material	D Outer Wrap	E Total Thickness
☐ Bare	☐ Mill Coated	☐ Coal Tar	☐ Glass	
☐ Coated	☐ Yard Coated	☐ Asphalt	☐ Felt	
	☐ Field Coated	☐ Somastic	☐ Concre e	
	☐ Unknown	☐ Other_____	☐ Other_____	_____

(4) Coating Condition

☐ Damage
☐ Defec ive Application
☐ Decomposition
☐ Good Condition

Bond ☐ Good ☐ Fair ☐ Poor ☐ N/A
Evidence of Soil Stress ☐ Yes ☐ No
☐ Other _____

(5) Environment

☐ Clay ☐ Cumoo ☐ Wet
☐ Loam ☐ Caliche ☐ Dry
☐ Sand ☐ Rock ☐ Moist
☐ Other _____
Depth of Cover (Inches) _____

(6) Recoat: ☐ No ☐ Yes Material Used _____

(7) Internal Coating *(If Line Cut Open)* ☐ No ☐ Yes Condition _____

(8) Magnetic Particle Inspection for S.C.C. *(10% of M.L.A When Surficent Coating is Removed)* ☐ No ☐ Yes

(9) Evidence of ☐ Corrosion ☐ Defec ☐ Damage
If Corrosion is noted complete below and back of report If Defec or Damage is noted complete back of report

Corrosion

(10) General Corrosion Information

A. Location
(1) ☐ External
(2) ☐ Internal

B Description
☐ Less than 10% complete front of report ☐ Greater than 10% complete back of report
☐ Pitting ☐ General Max. Depth _____
Length _____

(11) Cathodic Protection ☐ Impressed ☐ Galvanic ☐ Other _____

(12) Pipe-to Soil Potential at nearest point from Corroded Area _____ Date of Measurement _____

Corrosion Leak Information

( ) Soil Resistivity

A. Measurement at Leak Area _____ (OHM CM²)

B Date of Measurement _____

( ) pH of Soil Near Leak Area _____

Remarks _____

Distribution Original – Yerevan Office
Copy – Corrosion Control
Copy – Linear Operation Branch

Prepared by

Date

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AT-A-15
Back

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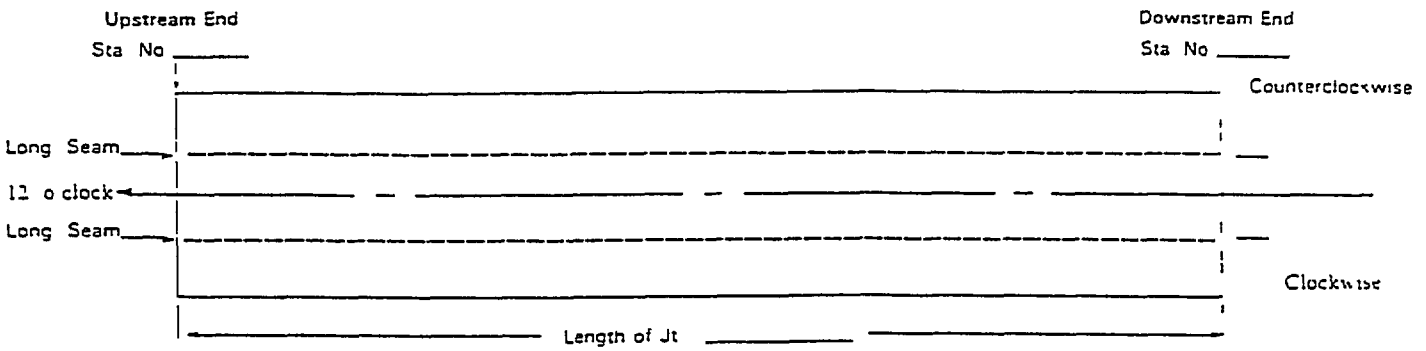
Defect Damage or Corrosion Investigation

Notes
1 Tabulate all dents gouges slivers corrosion S C C etc
2 Reference Point — Valve Tee ℄ Road etc as shown on Alignment Sheet with appropriate Station Number
3 Solid in one dashed line to depic long seam On seamless pipe measurements are to be made from the 12 o clock position If pipe is vertical substitute North for the 12 o clock position
4 Defec s such as dents slivers gouges etc shall be tabulated individually Corrosion cracks and/or corrosion pittings closely grouped may be tabulated as one defect
5 Defect width and length will be measured along the girth and longitudinal axis respec ively

Measurement from ☐Upstream Station ☐Downstream Station Flow Direction ☐ ☐



Number of Continuous Joints _____ This Dig

Defect Damage or Corrosion Measurements and Location							
No	Type	℄ Distance from Girth Weld	℄ Distance from Longitudinal Seam	Width	Length	Maximum Depth	Number of Cracks or Pits
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Repair Required ☐No ☐Yes Proposed Type of Repair _____

Type of Repair Required _____

1 Prepared by _____ Remarks _____

2 Checked by _____

3 Reviewed by _____

If pipe repair is required

4 Approved by _____ Remarks _____

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Front

ARMTRANSGAS

Leak Damage or Test failure Report — Transmission and Gathering Systems

Report Date

☐ Leak Report ☐ Test Failure Report ☐ New Construction
☐ Defect or Damage Report ☐ Existing Facility Year End

Instructions: Complete this side of this form for each incident regardless of cause Check appropriate box for specific cause of leak damage or failure and complete the pertinent part(s) on the reverse side

☐ Corrosion Part A
☐ Damage by Outside Forces Part B
☐ Construction Defect or Material Failure Part C
☐ Other *(Describe incident in detail in writing and attach to this form where parts A, B and C are not applicable)*

1 Description of Leak or Damage (Rupture Pinhole Dimensions etc.)

2. How Leak or Damage Detected: (Flame Ionization Patrols Landowners etc.)

3. Location and Time of Leak, Failure or Damage

a. Nearest Town | County | State

b. Facility Name | c. Mile Post | d. Survey Station No.

e Time of Detection (1) Date (2) Hour

f Elapsed Time Hr Min.
(1) Between gas detection and escape stopped
(2) Area made safe

g Estimated pressure at point and time of incident (PSIG)

h. Maximum allowable operating pressure (PSIG)

4. Date Installed

5. Origin of Leak, Failure or Damage

a. ☐ Body of Pipe g. ☐ Fabricated assembly
b ☐ Girth Weld h. ☐ Tap connection
c. ☐ Longitudinal weld i. ☐ Fitting *(Type)*
d ☐ Other field weld j. ☐ Gas cooler
e. ☐ Compressor k. ☐ Other *(Specify)*
f ☐ Valve

6. Material Which Leaked Was Damaged or Failed

a. ☐ Steel b ☐ Plastic c. ☐ Other *(Specify)*

7 Pipe Description

a. Nominal diameter *(Inches)* | b. Nominal wall thickness *(Inches)*

c. Pipe specification | D Grade

8. Leak or Damage Investigation Information

a. X Ray Findings

b Ultrasonic Findings

c. Other

9 Method Repair Date of Repair
☐ Temporary ☐ Permanent

a Pipe
(1) ☐ Weld Sleeve
(2) ☐ C amp
(3) ☐ Replace pipe length feet
(4) ☐ Other repair or disposition (Specify)

b Component
(1) ☐ Replaced (3) ☐ Other *(Specify)*
(2) ☐ Reconditioned

c. Full Specifications (Pipe) (Sleeve) (Component)

10 Personal Injury and/or Property Damage Resulting from Escape of Gas

a Number of employees
(1) Fatalities
(2) Suffering lost time injuries

b Number of non-employees
(1) Fatalities
(2) Injured and requiring medical treatment other than on site First Aid

	Yes	No
c. Rupture occurred	(1) ☐	(2) ☐
d Gas ignited	(1) ☐	(2) ☐
e. Explosion occurred	(1) ☐	(2) ☐
f Incident induced any secondary explosions or fires	(1) ☐	(2) ☐

g. Estimated repair cost and property damage plus property damage to others and cost of gas loss $

11 Environmental Description

a. Predominant type of area

(1) At time of construction	(2) At time of incident	(3) Type area
a ☐ Commercial	a ☐ Commercial	Class 1 ☐
b ☐ Industrial	b ☐ Industrial	Class 2 ☐
c ☐ Residential	c ☐ Residential	Class 3 ☐
d ☐ Rural	d ☐ Rural	Class 4 ☐
e ☐ Undeveloped	e ☐ Undeveloped	
f ☐ Unknown	f ☐ Other *(Specify)*	
g ☐ Other *(Specify)*		

b. Predominant above-ground structure adjacent to leak

	Multi Story	Single-Story
(1) Commercial	a ☐	b ☐
(2) Industrial	a ☐	b ☐
(3) Residential	a ☐	b ☐
(4) None ☐		
(5) Other *(Specify)*	a ☐	b ☐

c. Approximate distance to nearest above-ground structure (within one mile of leak) feet

d Did other underground facility(ies) contribute to occurrence of leak in any manner? (1) ☐ Yes (2) ☐ No

e If so what was effect on existence of other facility(ies)?

f Was (were) other utility(ies) imperilled by the leak?
(1) ☐ Yes (2) ☐ No

g Location of leak or failure
(1) ☐ Within building (5) ☐ Below walkway
(2) ☐ Above ground (6) ☐ Below road a ☐ Paved
(3) ☐ Below ground b ☐ Median or unpaved
(4) ☐ Below water (7) ☐ Below other paved area
(Specify)

h Depth of cover *inches*

i Soil information at pipe depth (1) ☐ Soil (2) ☐ Rock
(3) Estimated soil temperature at point of leak $^{0}_{F}$

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Back

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PART-A EVIDENCE OF CORROSION ☐ YES ☐ NO

PART-B DAMAGE BY OUTSIDE FORCES

1 Primary Cause of Leak

a ☐ Damage by equipment operated by or for operator
b ☐ Damage by equipment operated by outside party
c. ☐ Damage by earth movement
d. ☐ Other *(Specify)*_____

2. Locating Information for Excavating and Blasting Incidents

a When leak resulted from damage by outside party s equipment did the operator get prior notification that the equipment would be used in the area?

(1) ☐ Yes
(2) ☐ No
(3) Date
(4) Time

b Was the pipeline marked or identified? (1) ☐ Yes (2) ☐ No

(1) If Yes what type of marking or identification was used to advise outside party of location of pipeline?

a ☐ Permanent markers
b ☐ Map furnished
c ☐ Temporary stakes
d ☐ Paint
e ☐ Excavation
f ☐ On site observation
g ☐ Other *(Specify)*_____

c. Does statute or ordinance require the outside party to determine the location of pipelines?

(1) ☐ Yes (2) ☐ No

3 Damage by Earth Movement

a ☐ Subsidence
b ☐ Earthquake
c. ☐ Landslide
d ☐ Washout
e. ☐ Other *(Specify)*_____

f Was the earch movement caused by direc or indirec action of others? (1) ☐ Yes *(If Yes explain)* (2) ☐ No

PART-C CONSTRUCTION DEFECT OR MATERIAL FAILURE

1 Primary Cause of Leak a ☐ Construction defec ☐ Material failure

2. Explain All Known Facts and Related Conditions Pertaining to the Above

Additional Description of Incident or for Continuation of Explanation of Items Above or on Other Side

Distribution (Check Original and Each Copy As Appropriate)

Original – Director of Operations
Copy – Yerevan Office
Copy – Dispatch Office
Copy – Technical Services
Copy – Corrosion Control
Copy – Linear Operation Branch

Fax No

Signature of Reporting Supervisor | Date

ARMTRANSGAS

AT B-21

Pipeline Patrol and Leak Survey Report

Location _____ Line _____ Report Date _____

Leak Survey with Detection Equip ☐ Land Patrol ☐ Leak Survey ☐ Snorted Casing Survey ☐

Date	From M P	To M P	Miles	DOT Class	Remarks

Distribution.

Company Inspections: Original – Yerevan Office
Copy – Linear Operation Branch

Contract Inspections: Contractor is to prepare detailed report

Signed _____

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Valve Inspection Report

AT B 22

Linear Operation Branch _____ Line Service Station _____

Valve Number	Location	Date of Inspection	Operating Condition of Valve	Trip Point of Operator	Valve Position		Lubricant Yes/No (or Amount)	Remarks

Distribution Original – Yerevan Office Copy – Linear Operation Branch Signed by _____ _____

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ARMTRANSGAS

AT-B 23

Relief Valve Inspection Report

Name of Station	Name of Station			Date of Test
Make of Valve	Size & Type	Serial No	MfG.	ANSI Rating

Max. Operating Pressure	kPa
Set Pressure on Valve	kPa
Reuef Pressure	kPa
Reseat Pressure	kPa

Type Of Operational Test

- ☐ P Activate pilot only for set pressure
- ☐ PV Activate pilot & valve for set pressure check no gas blow thru valve
- ☐ PVB Activate valve in place observing set point & reseating pressure point

Flow Restrictions

What is the limiting area in square millimeters upstream of relief valve that the relief valve must be capable of relieving with maximum system operating pressure? _____ mm^2

The restriction is:

Pipe _____ ID(millimeters) Area = 785 (ID)^2 = 785 ( )^2 = _____ mm^2

Valve - Size _____ Type _____ Manufacturer _____ Fig No _____

Throat Area _____ mm^2*

Is restricting area less than the effective area of relief valve? ☐ Yes ☐ No

Is there a restriction downstream causing back pressure? ☐ Yes ☐ No *If yes explain below*

Describe _____

Relief Valve Capacity Calculations — V_r

Set Pressure (P) _____ kPa Effective Discharge Area(A) _____ mm^2* Coefficient of Discharge(K) _____*

Orifice Type _____* Sp Gravity (G) _____ Temp (T) _____ °C

$$V_r = \frac{0.116\ PAK}{\sqrt{(T+273)\ GZ}} = \frac{0.116\ (\quad)\ (\quad)\ (\quad)}{\sqrt{(\quad + 273)\ (\quad)\ (\quad)}} = \boxed{\quad} \text{ sm}^3/\text{hr}$$

Required Relief Capacity — V_r

Regulator

Make _____ Size _____ Pressure Upstream (P_1) _____ Downstream (P_2) _____

Temp. _____ °C. V_r ☐ sm^3/hr ☐ Capacity Table* ☐ Calculated

Meter Station Flow _____ sm^3/hr Source _____**

Compressor Unit Capacity _____ sm^3/hr Source _____**

Capacity Comparison Check

If V_r is greater than V_r relief valve is adequate. If not, relief capacity must be increased

☐ Capacity Adequate ☐ Capacity must be increased

Mechanical Condition

- ☐ Yes ☐ No** Did the relief valve operate correctly from a mechanical standpoint?
- ☐ Yes ☐ No** Was relief valve disassembled and cleaned?
- ☐ Yes ☐ No** Was pilot disassembled and cleaned?
- ☐ Yes ☐ No** Were all valves in proper position?
- ☐ Yes ☐ No** Was blowdown stack free of obstructions?

* From manufacturers data

** Explain under remarks (use back if necessary)

Remarks _____

_____

_____

_____

_____

_____ _____

Witness

Distribution Original – Yerevan Office Copy – Linear Operation Branch

ARMTRANSGAS

Inspection Record Temperature and Pressure Instruments

AT-B 24

Station No ________ ☐ Temperature Instrument °F ☐ Pressure Gauge PSI Tube No ________

Date Of Inspection 19 __	Make & Type Instrument	Range	Type Service and Location	Gauge Diameter	Readings: Before Adjustment	Readings: After Adjustment	Inspector Remarks Initials

Distribution Original – Yerevan Office Copy – Linear Operation Branch

Reviewed by ________________ ________________

ARMTRANSGAS

AT B 25

Report of Pigging Operations
Transmission Department

1 Print or type All Information | 2 Specify Quantity of Materials Recovered and Indicated Actual or Estimated | 3 Indicate Samples Collected for Analysis (Yes or No) | 4 Enter N/A (Not Applicable) in a Column When No Other Information Applies | Division | Line Service Station

Date	Line Section Designation Length and Size	Run Number*	Type Pig	Materials Retrieved				Analysis Sample	Remarks
				Oil	Water	Distillate	Solids (Specify)		

*Number Each Run Consecutively for Each Section Beginning Anew Each Calendar Year

Run Supervised by

Approved by

Distribution Original – Yerevan Office Copy – Linear Operation Branch

ARMTRANSGAS

AT-B 26

Cathodic Protection Report

BIMONTHLY ☐ REPORT DATE ____________

ANNUAL ☐ SURVEY BY ____________

STATE ____________

LOCATION	MILE POST/ STATION NO	PIPE TO SOIL POTENTIAL VOLTS			REMARKS	DATE
		LINE A	LINE B	Insulating Flange		

Part II

Meetings

Section A

Pipeline Integrity and Emergency Action Plan

A-1 Organization

The Armenian Natural Gas Transmission system falls under the jurisdiction of Armtransgas with its headquarters located in Yerevan , (See Appendix I-Page 1) Jurisdictionally, the transmission system is divided into seven sections called Linear Operation Branches (See Attachment I-Page 2) Each branch is managed by a Branch Director with the responsibility of all operations and maintenance within his area, including transmission, measurement communications and so forth Each Branch Director reports to the appropriate department head in Yerevan responsible for a particular activity

The transmission system includes nine transmission meter stations The stations at Arium and Bentonit measure the gas entering Armenia from Georgia, the only source of gas in that country The other seven meter station measure the gas going to the various distribution M&R stations for industrial use Appendix II – Pages 1, 2, 3 & 4) are the translation of a typical two-page daily gas accounting sheet, this one being for August 30, 1998 Please observe that the gas losses are calculated for each of the branches and then totaled The total gas loss for the day in question was 1 75% We were advised that the average gas loss is approximately 3%, which is a tremendous improvement over the average of 6% gas loss at the time of my previous visit This is probably primarily due to the elimination of leaks in the pipeline system

Each transmission meter station, (Photographs 28, 29 &30) is manned The attendant reports flow data to the branch dispatcher and the headquarters dispatcher every two hours by VHF radio (See Photographs 4, 5, 6, 7 and 8)

Each branch has mobile equipment and other equipment necessary for maintenance They also have a compliment of emergency tools and supplies

A-2 Discussions

The seminar pertaining to the Pipeline Integrity and Emergency Action Plan was conducted at the Armtransgas headquarters in Yerevan on Thursday, September 3, 1998 (Photographs 1, 2 and 3) It was attended by 13 key employees (See Appendix number III) The Armtransgas Transmission System is operated and maintained utilizing Russian regulations as a guideline Prior to the Seminar, each of the attendees was furnished a copy of the Pipeline Integrity and Emergency Action Plan prepared by IGC, which had been translated into Russian by the Burns and Roe Yerevan office

There was good participation by the attendees particularly in discussing the forms which are included in Part I, Section C of this document and shown as visual aids utilizing an overhead projector

Section B

Simulated Emergency

The simulated pipeline emergency exercise took place on September 4, 1998 It was coordinated through chief dispatcher Bairamian Artion (See Photograph 4) It was decided that the emergency would be a pipe failure between valves N46 and N47 (See Appendix IV)

The following is an account of the events of the Simulated Emergency

Time

14 46 – The Armtransgas headquarters dispatcher advised the Yerevan Linear Operations Branch dispatcher of the simulated emergency and asked that they take appropriate action

15 10 – A welding truck, the closest to the site at the time, arrived at the Emergency location

15 15 – Valve N46 was closed

15 18 – Valve N98 was closed

15·25 – Valve N47 was closed

15 30 – Valve N99 was closed

15 31 – Valve N100 was opened

It was confirmed that Valve in 97 was open

15.32 – All field parties were advised to return their valves to their original positions and return to their duties

Following the exercise the Yerevan branch director, Kairapetian Makitch and his Engineer came to the Armtransgas headquarters dispatch office to discuss the exercise with us During the conversation he emphasized that if it had been an actual emergency the area would be secured and local officials would be notified He listed for us, all of the equipment that was on the truck which was dispatched to the Simulated Emergency site He also stated that an operational welding unit and an operational bulldozer were on standby if needed I was quite impressed with the dedication and enthusiasm of the Armtransgas employees who participated in this exercise

Section C

Exit Meeting

At the request of IGC, an exit meeting was held with Mr Roland Adonts, Chairman of the Board and Executive Director of Armrusgasprom on the morning of Friday, September 4th, prior to my departure for the United States on the following day I advised Mr Adonts that all of my goals had been achieved for the trip to Armenia with the exception of the Simulated Pipeline Emergency exercise which was conducted that afternoon I advised Mr Adonts that, as in the past, the cooperation of the employees of Armtransgas was outstanding and very much appreciated

During our conversation I was advised that Armtransgas is now being compensated for almost all gas being delivered and have authorization to cut off service to end-users who fail to pay This is a complete change from the practice during my previous visit

I commended Armtransgas for reducing their gas loss from approximately 6% at the time of my previous visit to approximately 3% at this time He acknowledged my statement but also stated he realized they had further improvements to make

He advised me that they are now manufacturing their own gas distribution meters (See Appendix V, Pages 1, 2 & 3)

We discussed the report, "Abovian Pipeline System, Gas Storage and Technological Constructions, Rehabilitation Program for 1997-2000" This is covered in more detail in Part III "Transmission System"

I advised Mr Adonts that I had learned that the communications equipment purchased by USAID for Armtransgas had not been distributed because the equipment did not include battery chargers The battery chargers have now been ordered and distribution will be made when they are received

I had been advised, in the field, that three of the four gas leak detectors furnished by USAID were not operational because of the lack of parts Mr Adonts advised me that three of the four are operational I was unable to determine whether or not the spare parts

were on order I consider this an extremely critical item in assuring the safe operation of the system, particularly with the many leaks brought about by the lack of cathodic protection

We both agreed that it is extremely important to reestablish the cathodic protection system of the Transmission Pipeline as soon as money is available

I advised Mr Adonts of the importance, in my opinion, of marking the location of the pipeline by signs at road crossings, meter stations and valve settings He was in agreement and stated that on some sections of their system, signs were installed and they can obtain signs in Armenia There were no signs in the limited area of the transmission system that I visited during this trip or the previous trip

We had a general discussion on gas engines driving compressor units

Mr Adonts advised me that he would be attending the Seventeenth Congress of World Energy meeting in Houston starting on September 10, 1998 I furnished him with my office and home telephone numbers and volunteered to show him Skid Mounted Compressor units, which I would recommend for replacement at their salt cavern gas storage facility He acknowledged my invitation and indicated that I would hear from him

As usual our meeting was very cordial and enjoyable to me

Part III

Transmission System

Armenia's Armtransgas Transmission system continues to deteriorate because of the lack of cathodic protection and inadequate funds for repairs IGC was furnished a large map of the transmission system which indicated 12 places where there is corrosion, 6 where there is damage due to landfall and 5 where there is mechanical damage These problems are being rectified as money allows Some sections of the transmission system have been removed from service because of excessive gas leakage I was advised that the corrosion leaks were detected by conducting sonic surveys at the surface and where "voids" were detected in the coating, the pipe was excavated to inspect for corrosion

The Armtransgas transmission system includes nine transmission meter stations as follows

1 Bentonit-measuring gas coming from the Republic of Georgia

2 Airum - measuring gas coming for the Republic of Georgia

3 Sevan I

4 Sevan II

5 Dilijan Vanadzoz

6 Dzorakhbiur

7 Vanadzoz - Gumzi

8 Dashkert - Sermuk

9 Gozis-Stepanakert

A balance of the gas coming into Armenia from Georgia and the gas dispersed is indicated each day on a daily log sheet (See Appendix II - Pages 1, 2, 3 & 4) On the day shown, the unaccounted for gas was 1 75% I was advised that typically it runs approximately 3% which is a considerable improvement from the 6% I observed during my previous visit As you can see on the daily log sheet mentioned above, the unaccounted for gas is calculated for each of the Linear Operated Branches The director of each branch has responsibility of keeping the percentage unaccounted for to a minimum

IGC was asked how the difference in volume in line pack as the pressure varies, is accounted for in the United States Appendix VI, giving the formula, was E/mailed to Mr Bairamican Artiom, Chief Dispatcher of Armtransgas upon my return from Armenia Also, I am including as Appendix VII, a six page dissertation concerning unaccounted for gas

The Armtransgas Transmission system is divided into seven Linear Operation Branches, (Appendix VIII, Pages 1, 2, 3, 4, 5, 6 & 7), each headed by a Director who has the responsibility of all operation and maintenance in his branch The branches are listed as follows with the number of transmission meter stations in each

Dilijan (3), Abovian (1), Yerevan (0), Vanadzor (1), Gumir (2), Martuni (1) and Goris (1)

IGC was furnished a very voluminous and comprehensive report titled, "Abovian Pipeline System, Gas Storage and Technological Constructions, Rehabilitation Program for 1997-2000" I had spot translations made to give me an indication of what it includes As I said, it is very thorough The first eight pages of this report, included as Appendix IX, give the reader an idea as to what it consists of Photographs 9 through 24 showing transmission pipeline problems, were taken from this report

Armtransgas's transmission system is operated and maintained under Russian codes and Regulations For the readers information we are enclosing, as Appendix X, the

translation of the standard instruction on "Hot operations implementation of the existing pipelines, gas collection systems and gas storage stations transporting natural gas" Generally speaking these instructions are very similar to those of ASME B31 8 the American Code, with some exceptions As per example, "In-welding of patch", lines 69 through 72 of the Russian Instructions is not allowed for the transmission systems in the United States

Section I of this report, "Emergency Action Plan", stresses the importance of having emergency tools, equipment and materials The IGC representative visited the Yurevan Linear Operation branch and discussed this with the Director They seem to have adequate emergency tools and work equipment and the mobile equipment was in reasonably good shape but need improvement Photographs 32, 33 and 34 show pipe in storage I was advised by the Director that this pipe is for future construction and not emergency pipe He advised me that the emergency pipe is at strategic locations on the transmission system The pipe shown in Photographs 32 and 33 should be stored off the ground, as is that in Photograph 34

Attachment XI, Page 1, is the report of a leak on the transmission system including a map of the location Appendix II, Page 2, is a translation of the report Appendix XII is a translation of a nine-page "Plan for Organization and Performance of Hot Works in the Existing Operating Pipeline" It seems to be very thorough and complete

Part IV

International Gas Consulting, Inc.
Armenia Trip Report
August 25 - September 5, 1998

Trip Report

Tuesday, August 25

Enroute Houston to Amsterdam

Wednesday, August 26

Arrived in Amsterdam and to Yerevan

Thursday, August 27

Established in Burns and Roe Yerevan office Met with Gagik Danielian, Burns and Roe authorized representative and Sophia Naleandian, Translator

Friday, August 28

Meeting with Gabrelan Nicolay - Director of joint stock company "Haitransgas" and Jilivian Yuri, Deputy Director, to discuss purpose of trip, make plans to tour field facilities, and discuss dispatching and gas balance (Photograph 25) Meeting with Roland M Adonts, Chairman of Board, Executive Director of Armrusgasprom, Rouben Asatrian, Head of Foreign Affairs Department and Mikaelian Levon, Assistant, to discuss morning activities and plans

Telephone conversation with David Cooksley discussing trip progress and plans Gave copy of translated "Pipeline Integrity and Emergency Action Plan" to Mr Nicolay and Mr Juri for review

Saturday, August 29

Toured field facilities with Jilvian Yuri, Deputy Director of joint stock company, "Haitransgas" and members of his staff Tour included inspection of several road crossings, (Photographs 26 and 27), a transmission meter station, (Dzorakhbiur), the Yerevan branch dispatch center, the chromatograph installation located at the Yerevan

distribution meter station and the Yerevan linear operation branch office (Photographs 26 through 35)

Sunday, August 30

Organized notes and read translations

Monday, August 31

Meeting with Makobian David, Deputy Head of Production - Operations Department discussing the transmission system

A planned meeting with Jilvian Juri, Deputy Director, joint stock company "Haitransgas" was cancelled because of pipeline emergency

Tuesday, September 1

Meeting with Jilvian Juri and discussed pipe failure reports, transmission system maps and field organization Also, scheduled "Pipeline Integrity and Emergency Action" meeting

Meeting with Bairomian Artiom, Chief Dispatcher, discussing unaccounted gas, line pack and system gas flow

Discussed trip progress with David Cooksley by telephone

Wednesday, September 2

Jilvian Juri was not able to meet as scheduled because of previously mentioned pipeline emergency Processed information and worked on trip report

Thursday, September 3

Attended reception at USAID office for American Ambassador, Mr Topson and wife who will be leaving Armenia

Met with Winston McPhie, Assistant Director of USAID for energy

Meeting with Deputy Director, Jilvian Juri of joint stock company "Haitransgas"

Conducted "Pipeline Integrity and Emergency Action" Seminar (Photographs 1 through 3) Also see Part IIA

Friday, September 4

Exit meeting with Roland Adonts, Chairman of Board and Executive Director of Armrusgasprom (See Part IIC)

Simulated pipeline emergency exercise (See Part IIB)

Recognized at National Gas Engineers day celebration at Armtransgas office (See Photographs 36 through 39)

Telephone conversation with David Cooksley

Saturday, September 5

Yerevan to Amsterdam to Houston

APPENDIX I

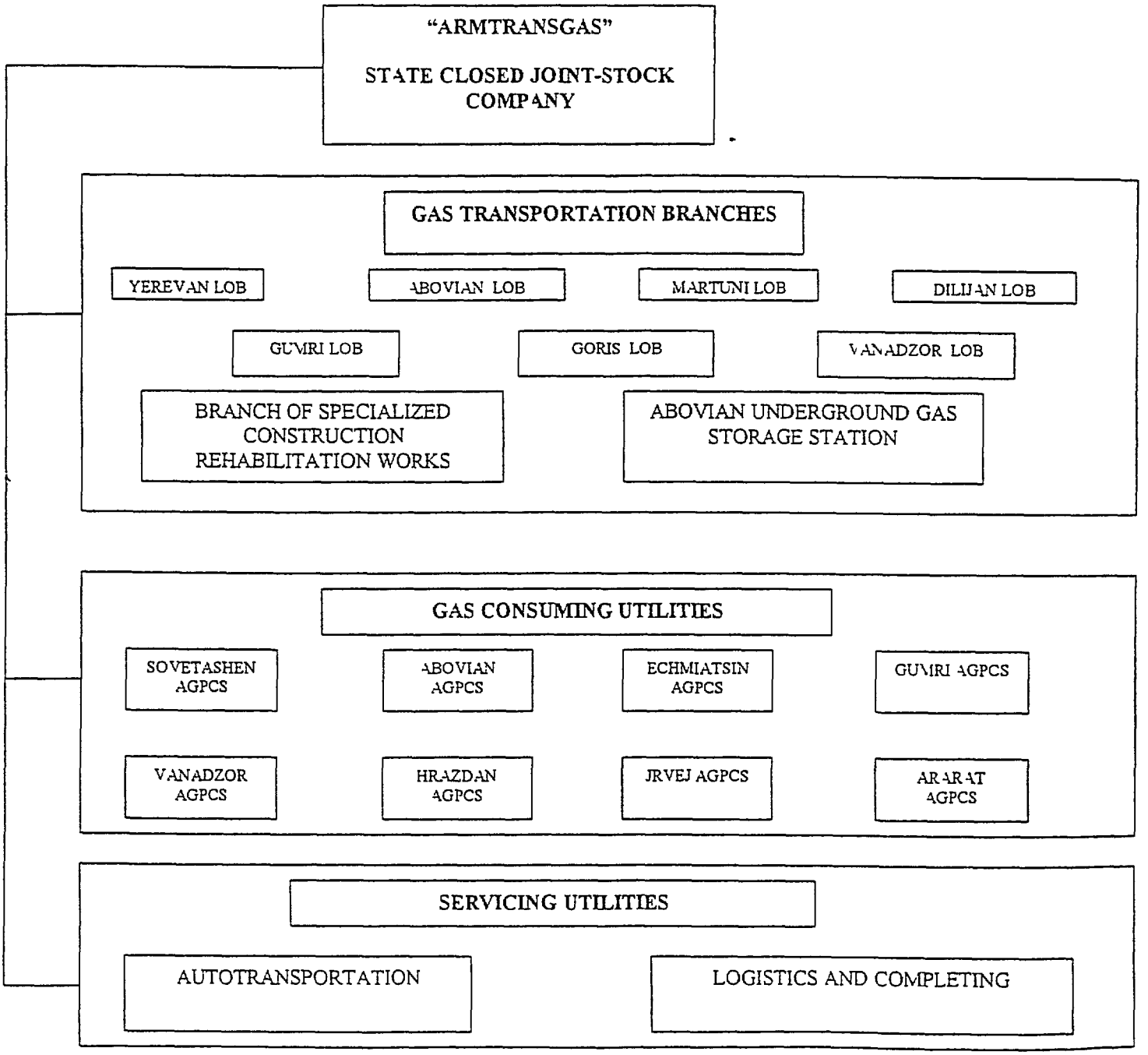
ARMTRANSGAS
STATE CLOSED
JOINT STOCK
COMPANY

APPROVED
RA MINISTER OF ENERGY
_____ G MARTIROSIAN
_____ 1998

EXECUTIVE DIRECTOR N GABRIELIAN

APPENDIX I

"APPROVED"
RA, MINISTER OF ENERGY
_____G MARTIROSIAN
_____1998



LOB – linear operation branch
AGPCS – automatic gas priming compressor station

EXECUTIVE DIRECTOR N GABRIELIAN

30-Aug

Karmir Kamurj	Bentonit	Airum	Bentonit	Karmir Kamurj - (B + A)	Pipe	Variance
1524 0	155 0	8 0	1563 0	-39 0	-96 29	57 29

29 Aug P1 = 11 50 P3 = 11 20 Qpipe = -96 29 P2 = 11 90

30 Aug P1 = 10 20 P3= 10 00 P2 = 9 50

ARMTRANSGAS

Karmir Kamurj	Commodity gas	System	Gas Storage Station			Own needs	Entry Loss		Commodity gas loss	
1524 0	2473 02	-381 3	Blowing	Withdrawal	Fuel gas	0		%		%
							43 28	1 72	43 28	1 75
			0	611	0					

DILIJAN LOB

Entry Karmir Kamurj	Supplied					System	Own needs	Entry loss		Commodity gas loss	
1524 0	Airum	Dilijan	Sevan-1	Sevan-2	Commodity gas	-230	0		%		%
	80	-46	69	1640	15 21			26 4	1 50	26 4	173 50

ABOVIAN LOB

Entry Sevan-2	Supplied		System	Gas Storage Station			Own needs	Entry loss		Commodity gas loss	
1640	Dzorakhbiur	Commodity gas	-90	Blowing	Withdrawal	Fuel gas	0		%		%
	200	2138 31		0	611	0		2 69	0 11	2 69	0 13

YEREVAN LOB

Entry Dzorakhbiur	Commodity gas	System	Own needs	Entry loss		Commodity gas loss	
200	263 24	-75	0		%		%
				11 8	4 28	11 8	4 47

MARTUNI LOB

Entry Sevan-1	Supplied		System	Own needs	Entry loss		Commodity gas loss	
69	Dashkent	Commodity gas	57 7	0		%		%
	0	10 54			0 76	6 73	0 76	7 21

GORIS LOB

Entry Dashkent	Supplied		System	Own needs	Entry loss		Commodity gas loss	
0	Lachin	Commodity gas	-5 20	0		%		%
	0	5 03			0 17	3 27	0 17	3 38

VANADZOR LOB

Entry		Supplied		System	Own needs	Entry loss		Commodity gas loss	
Airum	Dilijan								
8 0	-4 6	Taron	Commodity gas	-21 80	0		%		%
		0	24 22			0 98	3 89	0 98	4 05

GUMRI LOB

Entry Taron	Commodity gas	System	Own needs	Entry loss		Commodity gas loss	
0	16 47	-17 00	0		%		%
				0 53	3 12	0 53	3 22

GAS ENTRY AND EXIT REPORT BY "ARMTRANSGAS" FACILITIES

Entry Red Bridge	1524 0
Bentonit+Airum	1563 0
Bentonit	1555 0
Airum	8 0
Withdrawal from UGSS	611 0
Storage in UGSS	0 0
Commodity gas	2473 0
Yerevan	73 0
Hrazdan	2063 0
Vanadzor	8 5
Other	327 9
Energy facilities	2062 0
Yerevan	0 0
Hrazdan	2062 0
Vanadzor	0 0
Other	0 0
Cement Plants	156 0
Hrazdan Cement Plant	0 0
Ararat Cement Plant	156 0
Boiler-house	0 0
Industry	49 1
Public utilities	85 0

Georgia		
Entry		
Commodity gas		
Energy facilities		
UGSS	Storage	
	Withdrawal	
	Active gas balance	
AGPCS		28 9
Yerevan 1		8 2
Yerevan 2		10 0
Hrazdan		2 0
Jrvej		2 6
Etchmiadzin		2 2
Ararat		0 0
Vanadzor		3 0
Gumri		1 0

Entry	Flow
1 900	0 458
Start of month	Start of year
50191 0	891602 7
56088 2	815047 8
45667 8	558511 8
0 0	63626 0
10 495	28566 0

Own needs	0 0
System (+,-)	-381 30
Loss	43 3
	(1 72%)

TIME SCHEDULE

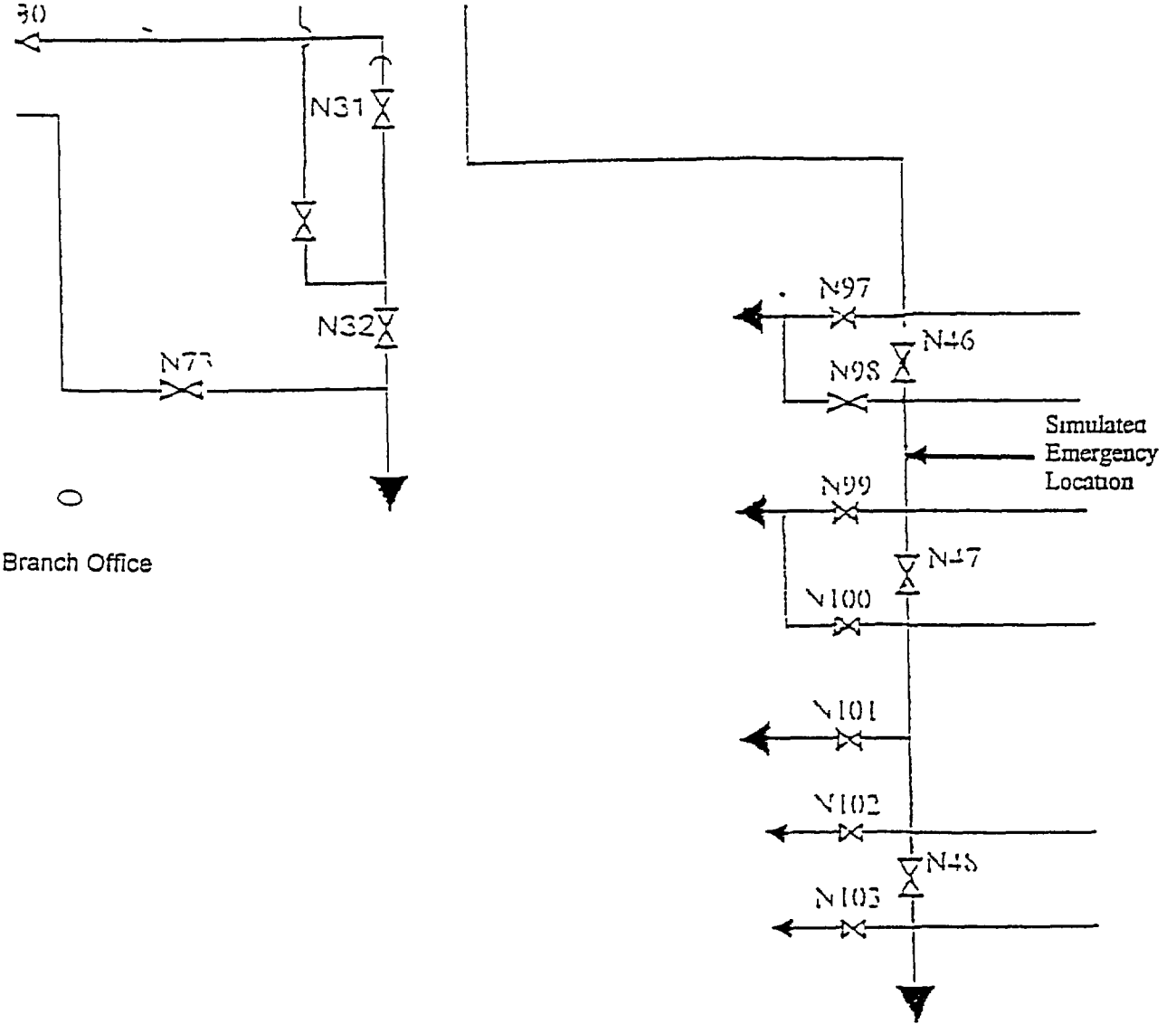
							1 Sep 98	
Name	Parameter	8 00	10 00	12 00	14 00	16 00	18 00	20 00
Mazdok	Pent/Pex	32 3/0 0						
Chmi	Pent/Pex	11 7/0 0						
	Q/h	79 0						
Bentonit	Pent	9 1						
	Q/h	40 0						
Airum	Pent	9 4/9 4						
	Q/h	0 0						
Total entry	Q/h	40 0						
Total flow	Q/h	92 6						
GDS-1	Pent	9 0						
	Pex/Qh	3 0/4 5						
GDS-2	Pent	0 0						
(TPP)	Pex/Qh	0 0/0 0						
(Nairit)	Pex/Qh	0 0/0 0						
(City)	Pex/Qh	0 0/0 0						
Hrazdan	Pent	8 0						
(TPP+State District PP)	Pex/Qh	5 5/81 0						
(Cement Plant)	Pex/Qh	0 0/0 0						
Vanadzor	Pent	10 0						
	Pex/Qh	0 0/0 0						
Ararat	Pent	8 7						
(New Cement plant)	Pex/Qh	0 0/0 0						
(Old Cement plant)	Pex/Qh	1 8/0 1						
Other	Q/h	7 0						
Energy facilities	Q/h	81 0						
Cement plants	Q/h	0 1						
GSS – injection	P/Q/h	0 0/0 0						
GSS – withdrawal	P/Q/h	8 8/33 0						

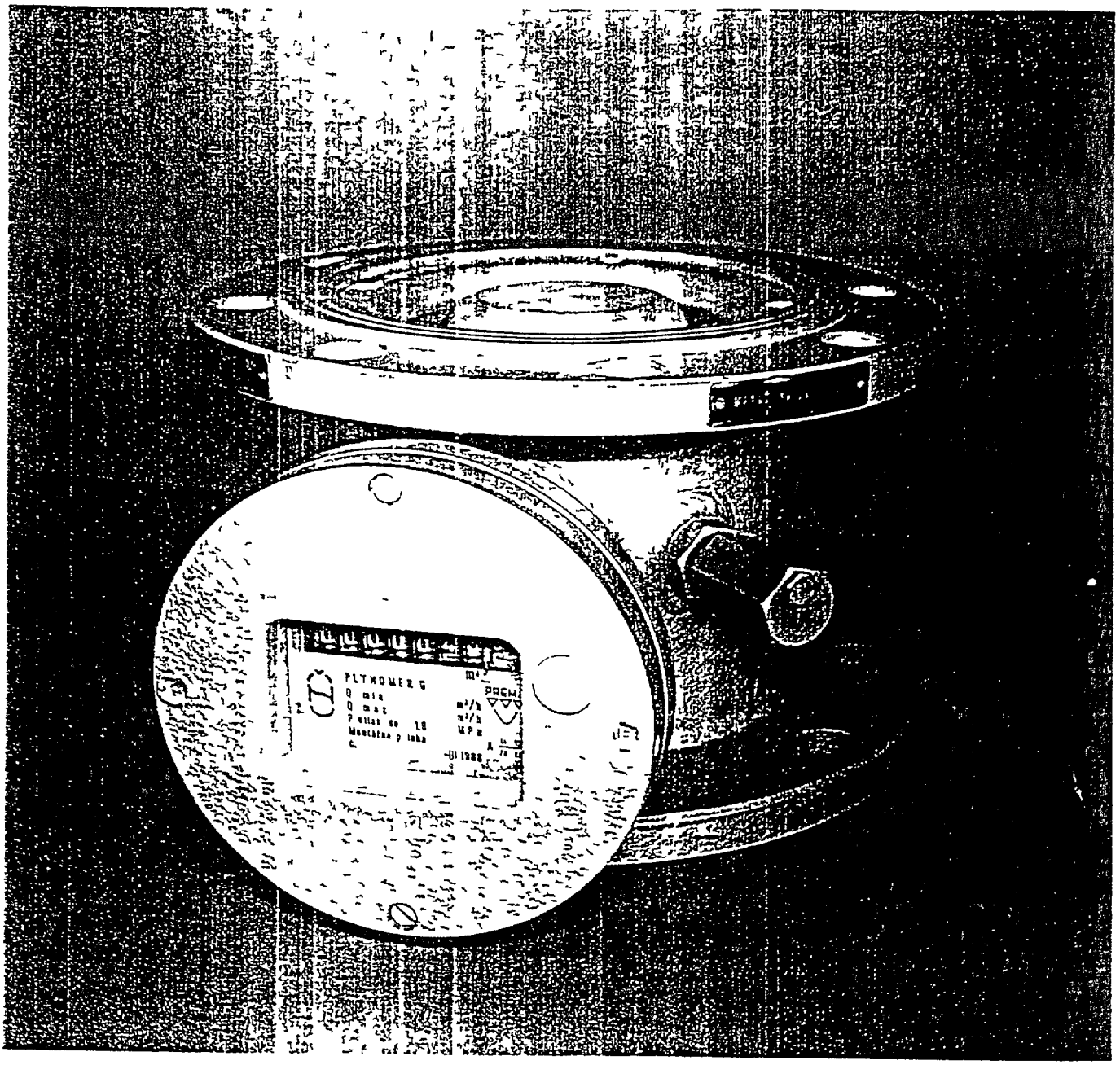
APPENDIX III

THE LIST OF "ARMTRANSGAS" EMPLOYEES, ATTENDING THE SEMINAR

1	Y Jilavian	-	Deputy Director
2	H Mikaelian	-	Assistant to Director
3	D Hakobjan	-	Deputy Head of Production-Operation Dep
4	M Hairapetian	-	Head of Yerevan LOB
5	G Nazarian	-	Head of Abovian LOB
6	A Sahakian	-	Foreman
7	L Pogosian	-	Head of Vanadzor LOB
8	Y Avetian	-	Deputy Head of Vanadzor LOB
9	A Khachatrian	-	Deputy Head of Gumri LOB
10	S Aklunts	-	Head of Goris LOB
11	J Markarian	-	Deputy Head of UGSS
12	G Pambukchian	-	Chief Dispatcher of Dilijan LOB
13	H Harutunian	-	Head of Safety

Simulated Emergency Action





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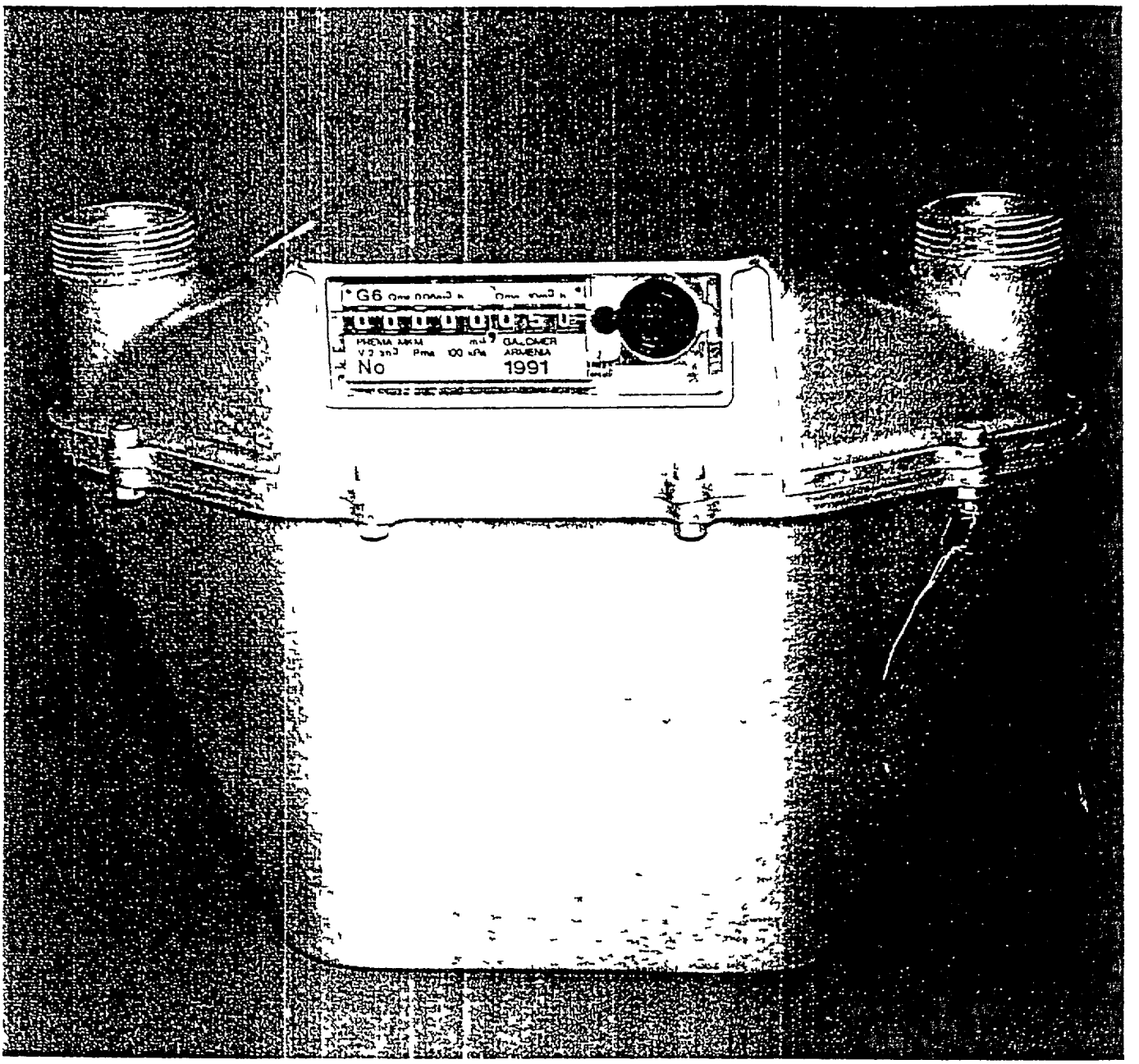
ТУРБИННЫЕ СЧЕТЧИКИ ГАЗА РПТ 3

PREMA

GASOMER



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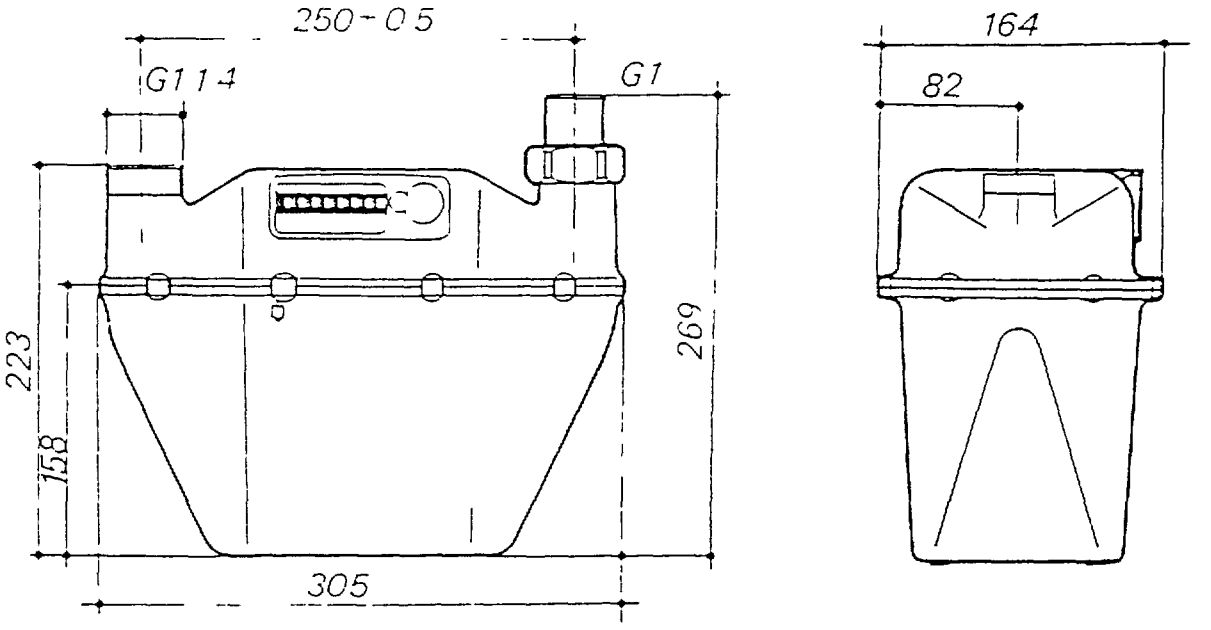
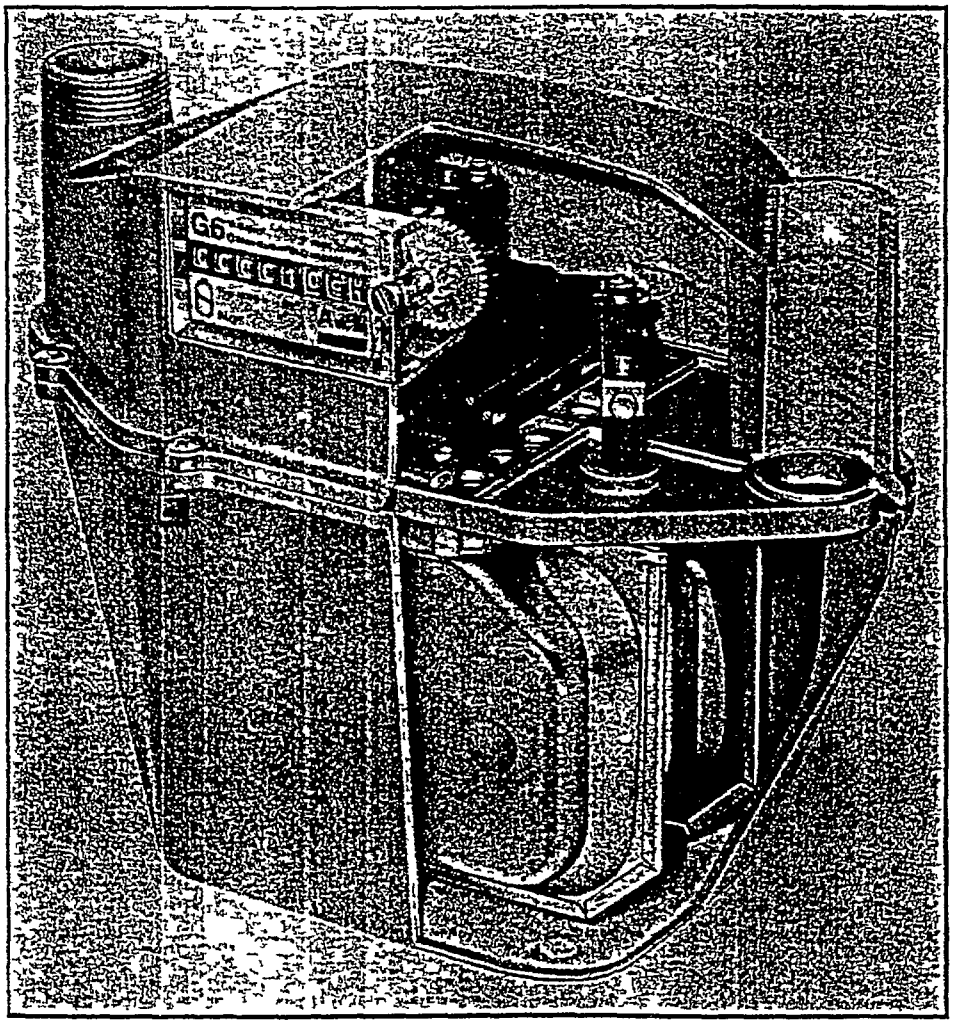
БЫТОВОЙ ДИАФРАГМЕННЫЙ СЧЕТЧИК ГАЗА ТИПА МКМ

G4
G6

APPENDIX V

BEST AVAILABLE COPY





375053 Ереван Арин-Берди пер. 4 корп. 9
Тел. 57 82 66 47 34 01
Телекс 243319 OLIMP SU Факс (885 2) 57 87 70
Р/с 206000002 Внешэкономбанк
Республики Армения г. Ереван
Код 370101202 Расчетный центр 200 ВЭБ
Р/с 3483 94857/110 Внешэкономбанк

APPENDIX VI

LINE PACK

To calculate the amount of gas in any Linear Operating Branch (LOB) at any given time, multiply the piping volume within the LOB (length of pipeline in meters multiplied by the cross sectional area in square meters, plus any adjustment for volumes of accessory piping, attached vessels, etc) by pressure, temperature, and compressibility factors

$$Q = \frac{P}{Po} x \frac{To}{T} x \frac{Z}{Zo} x V$$

Where Q= gas volume in standard cubic meters

P= Average LOB pressure- kilopascal absolute-kPaa

P_o= Standard pressure- kPaa

T_o= Absolute temperature at standard conditions- degrees Kelvin-(°C−273)

T= Average absolute gas temperature- degrees Kelvin

Z_o= Compressibility factor at standard conditions

Z= Compressibility factor at actual average gas conditions

V= Total LOB piping volume- cubic meters

Daily line pack differences, in conjunction with daily gas volumes measured into and out of each LOB, will provide a more definitive daily accounting of gas inventory

UNACCOUNTED-FOR GAS

Mike Haydell
ENTEX
A Division of Arkla, Inc

P O Box 550
New Iberia, LA 70562-0550

Unaccounted-for gas can be defined as the difference between the amount of gas purchased and the amount of gas sold through a measured gas distribution system." This difference is commonly described as a percentage of gas purchased *"PERCENT UNACCOUNTED-FOR GAS"*

Example

Unaccounted for Gas

Gas Purchased	50 000 cubic feet
Gas Sold	-45,000 cubic feet
	5 000 cubic feet

Percent Unaccounted for Gas

Unaccounted-for Gas	5 000 cubic feet x 100 = 10%
Gas Purchased	50 000 cubic feet

Unaccounted-for gas figures can be either positive (more gas purchased than sold) or negative (more gas sold than purchased) In either case, it is important to determine what factors are contributing to the unaccounted-for gas and eliminate them. We are concerned about unaccounted for gas for two reasons, safety and economics Concern about unaccounted-for gas for public safety include. leakage third party damage and gas theft. These factors contribute to unaccounted-for gas that can adversely affect the safety of our customers Economically, unaccounted-for gas represents lost revenues that are not recoverable It is gas purchased from a supplier but not sold to customers (positive unaccounted-for gas)

There are two types of unaccounted for gas

1 Operational
2 Accounting

Individually or together they make up the total unaccounted-for volume for a natural gas distribution or transmission system

Operational Unaccounted-for Gas

Operational unaccounted-for gas exists because of the day-to-day practices of purchasing, transporting and selling of natural gas

Events resulting in operational unaccounted for gas could be

A Leakage
B Measurement
C Pressure Regulation
D Third Party Damage
E Construction Activity
F Theft

Leakage

Leakage is the action of unmeasured gas passing from within a transmission/distribution system to the outside atmosphere. Leaks can occur on pipe walls, at welded screwed, or flanged connections, at couplings and at valve stems Generally, leaks can appear at any point on a pipeline/main/serviceline and on any object attached to the system (figure 1) Causes of such leaks on the system might be improper assembly or maintenance, faulty material damaged equipment or corrosion

Figure 1 Leakage in a gas system can have an effect on unaccounted-for gas

The volume of gas lost is dependent upon the size of the hole (or orifice) and the pressure on the system. The larger the size of the hole or the higher the pressure, the greater the volume of gas lost If a pipe has a one-inch hole with 25 psig of pressure on it then 39,700 cubic feet per hour will escape However if the pressure was only 10 psig then only 18 600 cubic feet per hour would escape A very economical way of reducing unaccounted-for gas associated with leakage is reduction of system pressure A gas system should be operated at the safest minimum pressure that will allow adequate service to the customer Controls can be added to the system in the form of telemetering temperature boosters and regulator stations to ensure that the customers demand can be met Figure 2 illustrates the effect system pressure has on a 0 250" hole

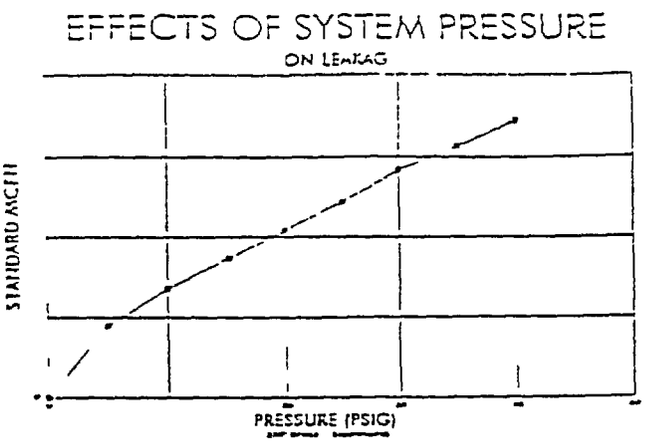


Figure 2 The effect of system pressure on leakage

We have discussed how pressure effects leakage but the size of the hole can also effect leakage A 125 inch hole on a pipeline with 25 psig on it will pass 620 cubic feet per hour If this leak is not detected for a year then 5 430 000 cubic feet of gas will be lost Therefore a small leak can be just as detrimental as a large leak

Some companies have set up departments dedicated to conducting leak surveys These surveys require personnel to walk the facilities with equipment specifically designed to detect leaks The two primary devices are combustible gas indicators and flame ionization units

It is also possible to visually inspect the pipeline/service by conducting a vegetation survey and soap test Gas seeping through the soil to the atmosphere will kill vegetation on the surface This provides a tell-tale sign of leaks The soap test consists of applying a foaming agent to the suspected object and looking for bubbles Gas leaking through will cause the soap to foam

Another method of detecting leaks is increased odorization If the amount of odorant injected into a system is increased for a short period of time an increased number of customers will call in leak complaints This procedure puts customers to work in surveying the system for leaks This practice should only supplement not replace company leak surveys

Once leaks are found they should be reported promptly to the construction department The construction department will correct or repair the leaks by placing clamps over them replacing the section of pipe or installing new fittings

Measurement

A new meter placed in service is designed to measure dry clean natural gas accurately However the gas flowing through our systems is not always dry or clean As time goes by the gas condition can affect the meters causing them to measure inaccurately Dirt and grit may collect on the impellers of a rotary meter distillate may dry out the bearings of a turbine meter or an orifice plate may get nicked These are some of the reasons why meters are field tested periodically or incorporated into an exchange program Most companies have a meter exchange program for their residential meters After a period of time the meters are removed from service and brought back to the meter shop to be tested They are then put back into service

If a meter allows one cubic foot of gas to pass, it should register the same amount Assume that the actual quantity of gas purchased is 10 000 cubic feet, but the purchase meter is 1% fast measuring more gas than actually passes through the meter Then it will register 10,100 cubic feet If the company that bought the gas sold it to a customer where the meter was 1% slow, measuring less gas than it actually passes through the meter, the meter would record only 9 900 cubic feet The total difference would be 200 cubic feet or 2% unaccounted-for gas (figure 3) This is why it is necessary for meters to be tested routinely Untested meters can have detrimental effects on the percent of unaccounted-for gas

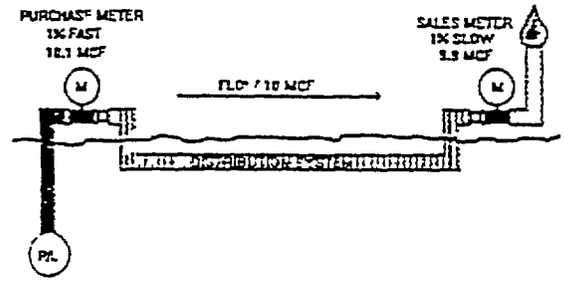


Figure 3 The meters must be measuring the gas correctly or there will be errors

Pressure Regulation

Most residential and small commercial customers appliances require a pressure of 4 osig to work properly In some cases the equipment may require a higher pressure These customers volumes should be compensated for by using a fixed factor multiplier or a pressure compensating index In either case it is important that the regulator be set at the correct pressure

If a regulator is set at a pressure different from that for which the customer is being billed there will be unaccounted-for gas Figure 4 illustrates the effect on measurement at pressures other than that for which the customer is being billed The customer in figure 4 is being served at an elevated pressure of 5 psig and billed on a fixed factor multiplier If the dial difference for the month is 743 1 mcf and the multiplier for 5 psig were applied the customer would be billed for 1000 mcf If in fact the pressure was 8 psig, for example, the customer would actually receive 1153 mcf This represents a loss of 153 mcf or 15 3% unaccounted-for Therefore service personnel must take care to ensure that a newly-installed regulator is set at the pressure for which the customer is being billed

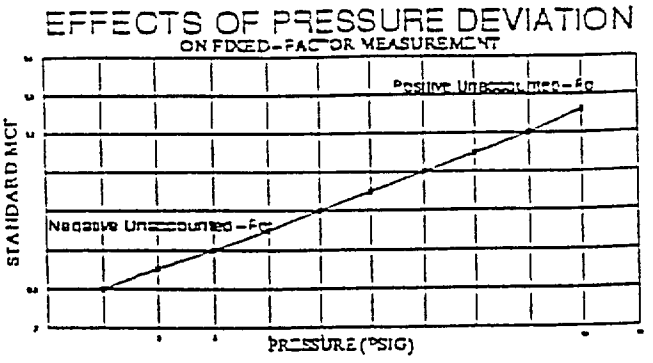


Figure 4 The effect of deviation in pressure on unaccounted-for gas

Also if the regulator is not responsive to changes in the load, the pressure will fluctuate causing the same type of unaccounted-for error The effects of boost and droop must be considered when choosing a regulator for fixed factor measurement

Third Party Damage

Outside contractors working near natural gas pipelines and mains will inadvertently damage the pipe causing gas to escape to the atmosphere This not only causes an increase in the unaccounted-for figure but also endangers human life The best way to prevent third party damage is through a "call before you dig" program (figure 5) This requires contractors who are installing water mains roads storm drains, etc to notify utility companies of impending construction near their facilities Once notified the company will send personnel to the site to mark the company's facilities Most companies estimate the gas loss and expense incurred in repairing damaged facilities and charge the contractor responsible for the incident However the gas escaping from a damaged pipeline can only be estimated

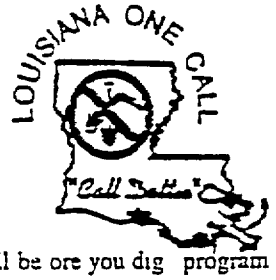


Figure 5 A call before you dig program helps prevent third party damage

Construction Activity

Gas that is purged from a pipeline during construction can be a factor in the unaccounted-for During major construction projects it is advisable to estimate the amount of gas that will be purged throughout the operation The figure could be useful in understanding the cause of unaccounted-for gas in a system. This could be insignificant if this is a normally high volume system However it can be a factor in smaller systems

Theft

The unaccounted for gas attributable to theft is an economic and safety concern of the natural gas industry We are interested not only in lost revenues but also in eliminating dangerous customer actions such as making illegal connections or tampering with meters The percentage of customers that steal gas will vary in every region of the country In some areas the problem is so wide-spread that special departments have been set up within companies to investigate and prosecute gas theft In other areas meter readers are on the alert to look out for illegal connections and meters that have been tampered with Another method is to seal all meters and monitor the seals If a seal is broken and the meter has been tampered with then the customer should be prosecuted This has proven effective in reducing incidents of gas theft

Accounting Unaccounted-for Gas

Accounting unaccounted-for gas results from transferring actual information into data and then into reports This consists of

A Contractual
B Chart Integration
C Data Entry
D Cycle Billing
E. Report Compiling

Basically accounting unaccounted-for gas takes place in the office, while accounting operational unaccounted-for gas occurs in the field

Contractual Unaccounted-for Gas

Contractual unaccounted-for gas is a constant percentage specified in a contract between the buyer and seller This clause might be written into a contract when gas is bought and sold through the same meter If the seller believes he is losing gas due to compression fuel usage meter wear or leakage he may require the buyer to compensate him for the gas The following example shows how the contract with 5% unaccounted-for gas would be used in calculating the total amount of gas purchased

Example

Volume measured by the meter	50 000 cubic feet
Percent unaccounted for specified in the contract	x 5%
Volume added to the bill	2 500 cubic feet
Total volume purchased	52 500 cubic feet

The contractual unaccounted-for gas also may be allocated as fuel usage such as gas that is used to fuel compressor power pneumatic controllers or supply pilot regulators

Data Entry

Once the charts are calculated and the meters read the data is entered into the computer The computer can be utilized to generate the customers volume statements and gas bills Incorrec data entered into the computer or a mistake made in data entry, will result in billing errors Errors show up as unaccounted-for gas In some offices the data is entered twice and compared, to ensure that data entry errors are caught and eliminated Also auditing the existing customer data files allows errors to be found If a customer is served on elevated pressure (any pressure above 4 osig) he must be billed for it This can be done by using a fixed factor multiplier It is important that the correct factor be used in calculating the volume If incorrec factors are used then the unaccounted-for gas will be affected

Cycle Billing

A distribution company cannot read all of the residential, commercial or industrial meters in one day Therefore, the meters are divided up into routes, with each route being read by a different meter reader on a different day Each day that the routes are read is called a billing cycle For instance, a meter may be read on February 3rd, with the gas usage being accounted-for in February Even though the gas was actually consumed during the previous month of January

Transmission companies usually have a limited number of large volume customers Therefore, they can read most of their meters in one day (or during one billing cycle) The difference in billing cycles between the transmission and distribution company can add to the accounting unaccounted-for gas This is most evident during the winter months when cold weather does not occur in two consecutive billing periods (the two months do not have the same number of Heating Degree Days) If colder weather occurs in the previous month, then the unaccounted will be positive This is because more gas was purchased by the distribution company in the previous month than was billed to the customers

Reports

Unaccounted-for gas reports can be helpful in highlighting systems with unaccounted-for problems Reports can be compiled to show monthly unaccounted-for information or 12-month unaccounted-for history The monthly reports provide detailed information on each system such as the volume of gas purchased and sold the amount and percentage of unaccounted-for gas, and yearly information To compile a report like this it is benefic al to assign source of gas codes to each customer These codes represent the source from which the gas is allocated to the customers This way customer volumes can be compiled by supplier or gas system (town) If the source of gas code is incorrect for a particular customer then their volume will not be used in calculating the unaccounted-for gas for that system This could result in a large unaccounted-for figure The monthly report only gives you monthly information In order to evaluate the validity of the monthly report a 12 month report is used to provide the monthly percent unaccounted-for gas for 12 months This can be used to spot trends for each gas system If the percentages are increasing it might be worth investigating

Charts

Charts are used to record the pressure, volume and temperature The first step in reducing the unaccounted-for gas associated with charts is to ensure that the recorders are recording the three variables correctly Are the pens marking? Is the mechanical clock wound up? Is the chart installed correctly? Is the recorder calibrated? If the answer to any questions is no, then the volume will be incorrect You may end up estimating the customer s bill, thereby increasing the percentage of unaccounted-for gas

Once the chart is removed, it must be correctly integrated to provide the correct volume If the pressure on the chart is constant this is easy to do However, this does not always happen Sometimes the pressure fluctuates If three people integrated these charts, you could not expect their results to be closer than ± 1% to ± 3% In order to alleviate this problem an equipment change would be required in the field Changes could include installing a more responsive regulator a mechanical integrating gauge, an electronic integrating gauge a flow computer, or a real time measurement system.

The day that a chart is taken off the meter can effect the unaccounted-for figure Some suppliers change the charts at the end of the month while the company that purchased the gas may remove their charts on the closest workday (figure 6) This can have an effec on the difference between the amount of gas bought and sold for that month If the purchaser removes his charts early and then cold weather occurs, the supplier may record more gas sold than the purchaser The end result would be a high percentage of unaccounted-for gas even though no gas was actually lost.

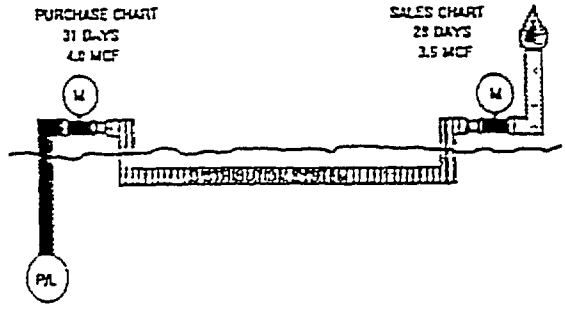


Figure 6 The number of days that a chart is left on the meter can effect the accounting unaccounted-for gas

The volume would be recorded on the next month s charts, thus balancing out the previous month s unaccounted-for gas One month the unaccounted-for gas may be 25% but the next month it might be -20% If the two months are added together the total unaccounted-for gas is 5%

Reducing the Unaccounted-for Gas

So far we have talked about the different types of unaccounted-for gas and their related causes Also we discussed different ways of reducing the unaccounted-for gas Before we begin reducing the unaccounted-for gas, we must determine what type it is The best way is to systematically investigate the gas system (figure 7) Once a thorough investigation is completed, then the appropriate steps can be taken to correct the problems It is important that while conducting the investigation you stay calm understand the layout of the system and talk to the individuals who operate the system. These three steps will make it easier to begin narrowing down the causes of the unaccounted-for gas

REDUCING THE UNACCOUNTED FOR GAS (A SYSTEMATIC INVESTIGATION)

Type of Unaccounted-for Gas	Action
OPERATIONAL	
Leakage	1 Leak survey the system.
	2 Report all leaks found to the construction department.
	3 Increase the odorant injection rate and follow up on all customer leak complaint calls
	4 Soap test all connections on new equipment installations
	5 Conduct a pressure study of the system to determine the minimum pressure required
	6 Install regulators, boosters, or telemetry equipment to reduce the system pressure
Measurement	1 Witness the supplier s field tests of purchase meters
	2 Set up a program to routinely field test large meters
	3 Set up an age change program to test small meters
	4 Continually monitor all meter test results
	5 Retire meters that are continually out of proof
Pressure Regulation	1 Inspect all regulators used to serve customers on fixed factor billing This will ensure that they are set on the proper pressure
	2 Monitor the performance of the existing regulators retiring regulators that are not responsive enough to flow fluctuations
Third Party Damage	1 Advertise a "call before you dig" phone number for contractors use
	2 Send individuals to the field to mark your facilities before construction beg ns
	3 Charge contractors for the expenses incurred repairing damaged pipelines
Construction	1 Estimate the amount of gas purged during construc ion ac ivities Include this amount in the unaccounted for gas reports
	2 Install valves to allow you to isolate sections of the pipeline when purging
Theft	1 Alert me er readers to watch for illegally by-passed meters
	2 Set up an award program for employees finding customers s ealing gas
	3 Seal meters and monitor the seals
	4 Prosecute customers stealing gas
	5 Generate a report of customers with anomalously low gas consumption

Figure 7 A systematic investigation of gas system allows you to narrow down the reason for unaccounted-for gas

Type of Unaccounted-for Gas	Action
ACCOUNTING	
Contractual	1 Locate all areas where contractual unaccounted-for gas is used 2 When renewing gas purchase contracts, negotiate the percentage of unaccounted for gas
Charts	1 Replace as many charts as possible with fixed fac or billing, mechanical integrating gauges, electronic integrating gauges, flow computers or real time measurement systems 2 Set up a program to have the charts audited by an outside firm 3 Install regulators that are responsive to flow variations This will provide a constant pressure which is easier to integrate on a chart
Data Entry	1 Write down all data to be used for calculating volumes so that it is legible 2 Generate a report listing customers that are fixed factor billed Use the list to ensure that the correct factors are being used 3 Audit customer data to ensure that it is coded correctly
Reports	1 Monitor the monthly and 12 month unaccounted-for gas reports 2. Check to ensure that the source of gas codes are correct for each customer 3 Report all changes in a gas sytem, such as new suppliers or tying systems together so that the unaccounted-for gas reports can be corrected
Sanity	1 Stay calm while investigating causes of unaccounted-for gas 2 Understand the layout of the system being investigated 3 Talk to the individuals who operate the system for leads

Figure 7 (Cont d) A systematic investigation of gas system allows you to narrow down the reason for unaccounted-for gas

Gas Pipeline Technological Chart of Dilijan Branch

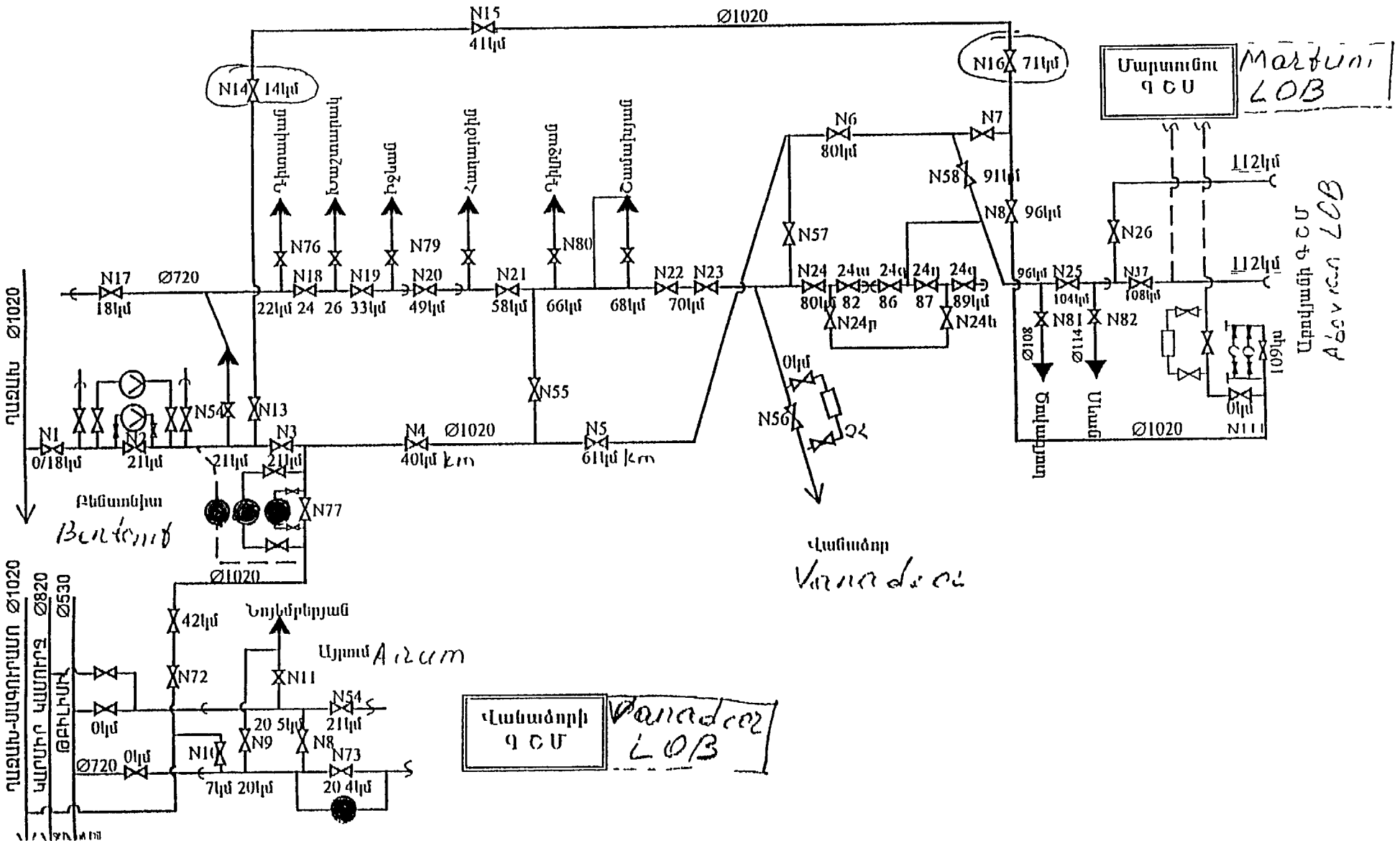
«Հաստատում եմ»
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

_____Ն Գ աբրիելյան

«_____» _____ 1998թ

(1)

Դիլիջանի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա



APPENDIX VIII

Gas Pipeline Technological Chart of Abovian Branch

Աբովյանի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա

«Հաստատում եմ» (2)
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

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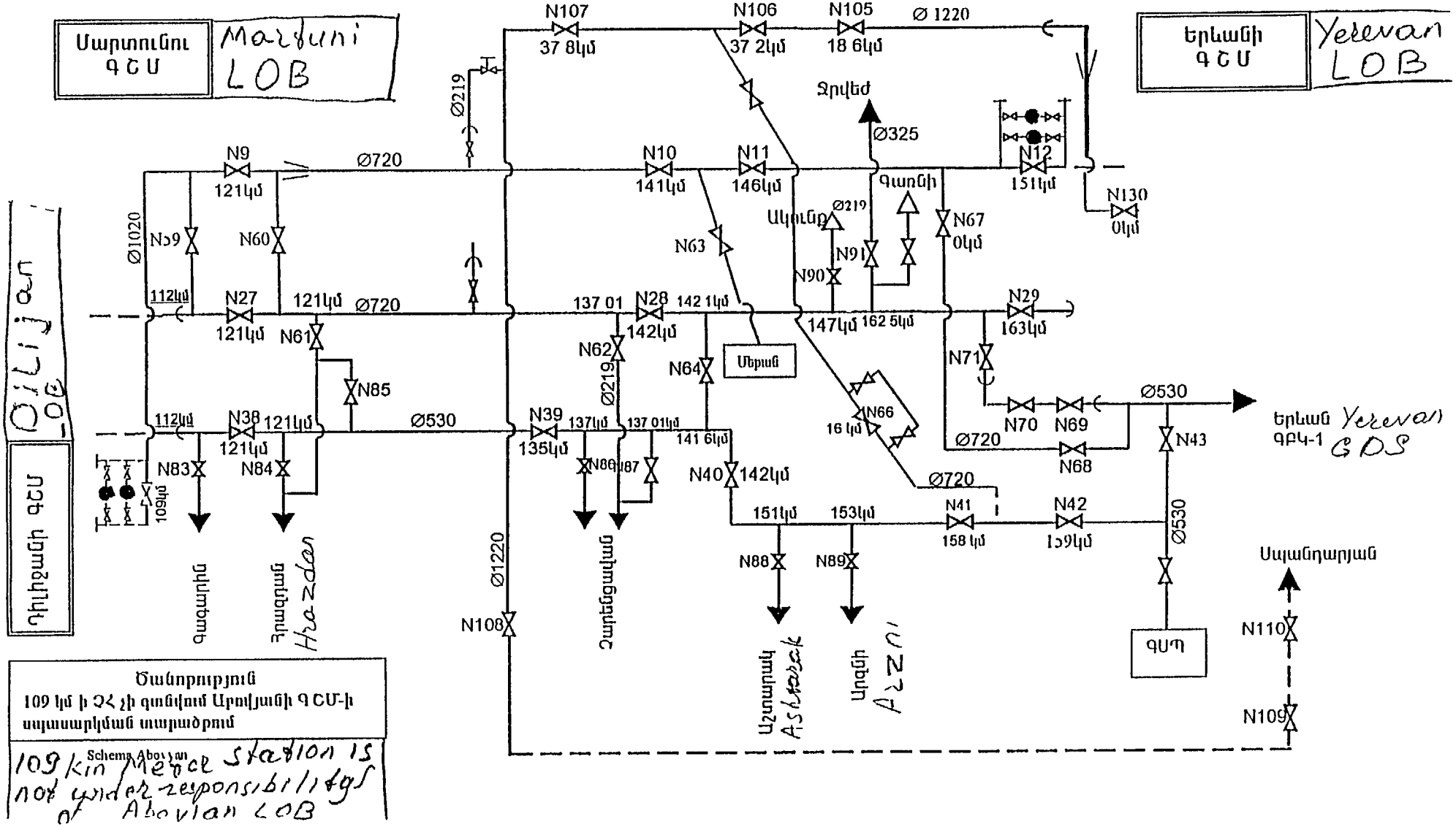

Gas Pipeline Technological Chart of Yerevan Branch

Երևանի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա

«Հայտրանսգազ» ՊՓԲԸ տնօրեն
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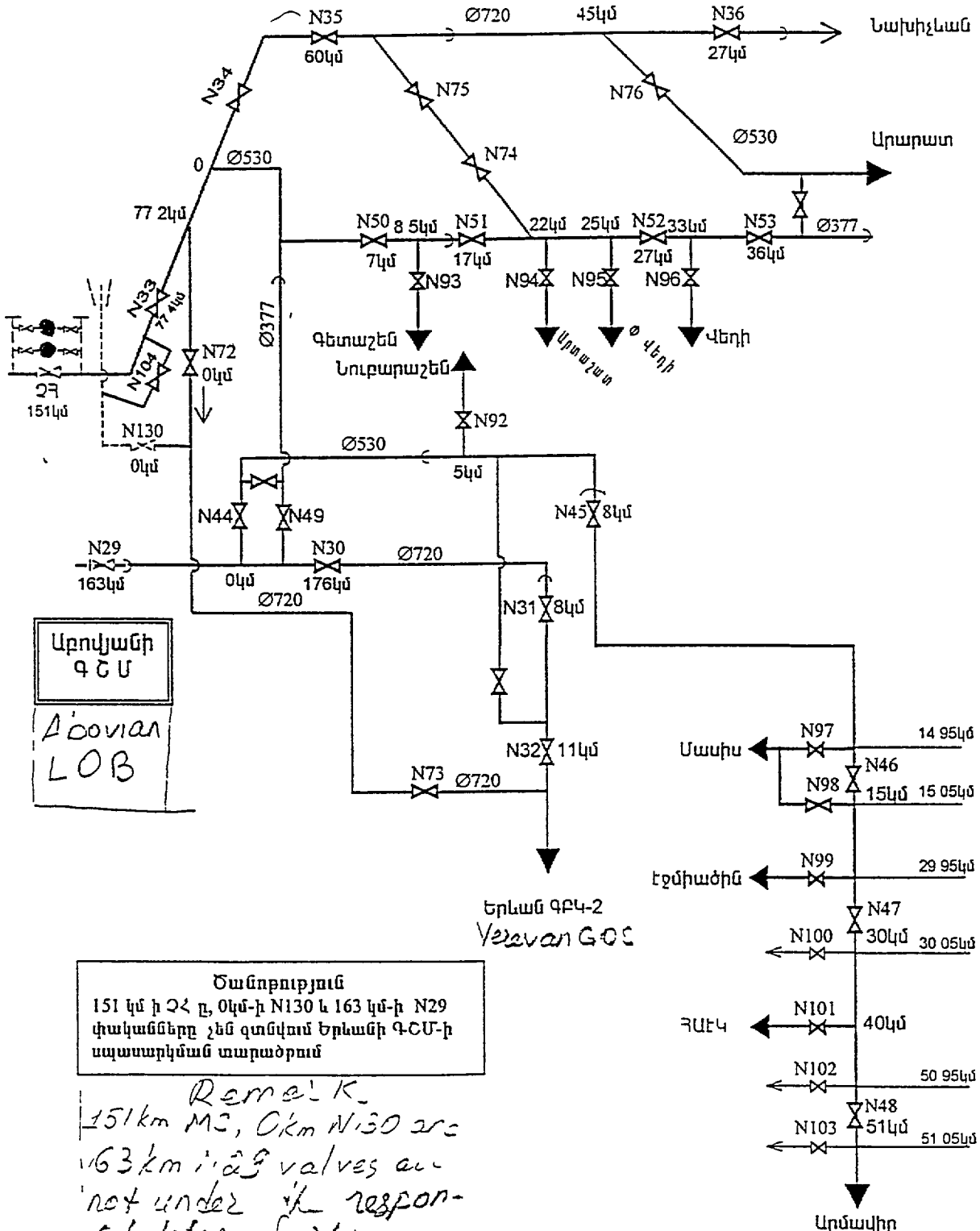

Ծանոթություն
151 կմ ի ՉՀ ը, 0կմ-ի N130 և 163 կմ-ի N29 փականները չեն գտնվում Երևանի ԳՇՄ-ի սպասարկման տարածքում

Remark
151km MS, 0km N130 and 163km valves are not under the responsibility of Yerevan LOB

APPENDIX VIII

Gas Pipeline Technological Chart of Vanadzor branch (4)

Վանաձորի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա

«Հաստատում եմ»
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

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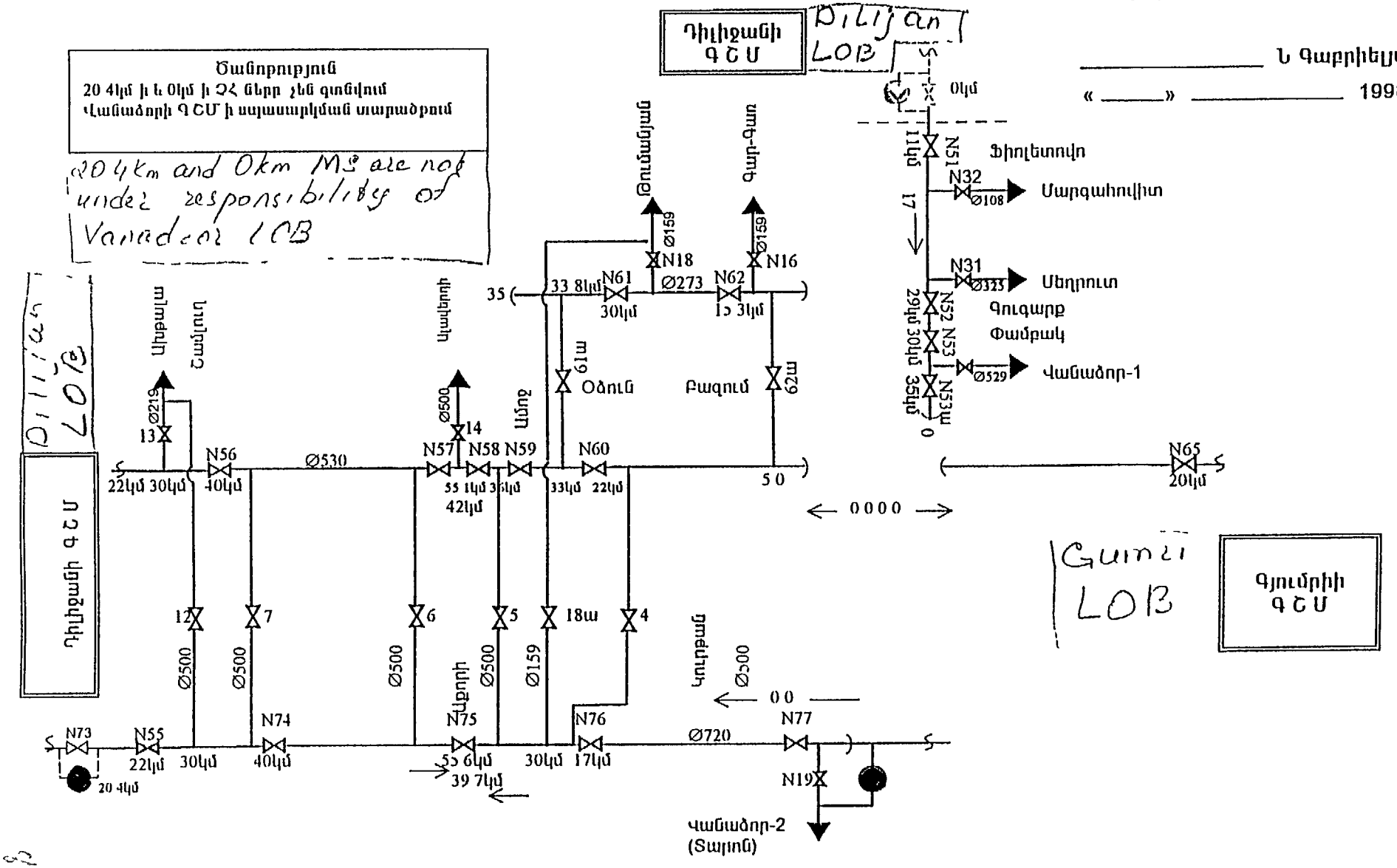
Ճանապարհ
20 4կմ ի և 0կմ ի ՉՀ ներր չեն գտնվում
Վանաձորի Գ ԸՄ ի սպասարկման տարածքում

20 4km and 0km MS are not under responsibility of Vanadzor LCB



Schema Vanadzor

APPENDIX VIII

(5)

Gas Pipeline Technological Chart of Gumri Branch

«Հաստատում եմ»
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

Գյումրիի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա

Ն Գաբրիելյան

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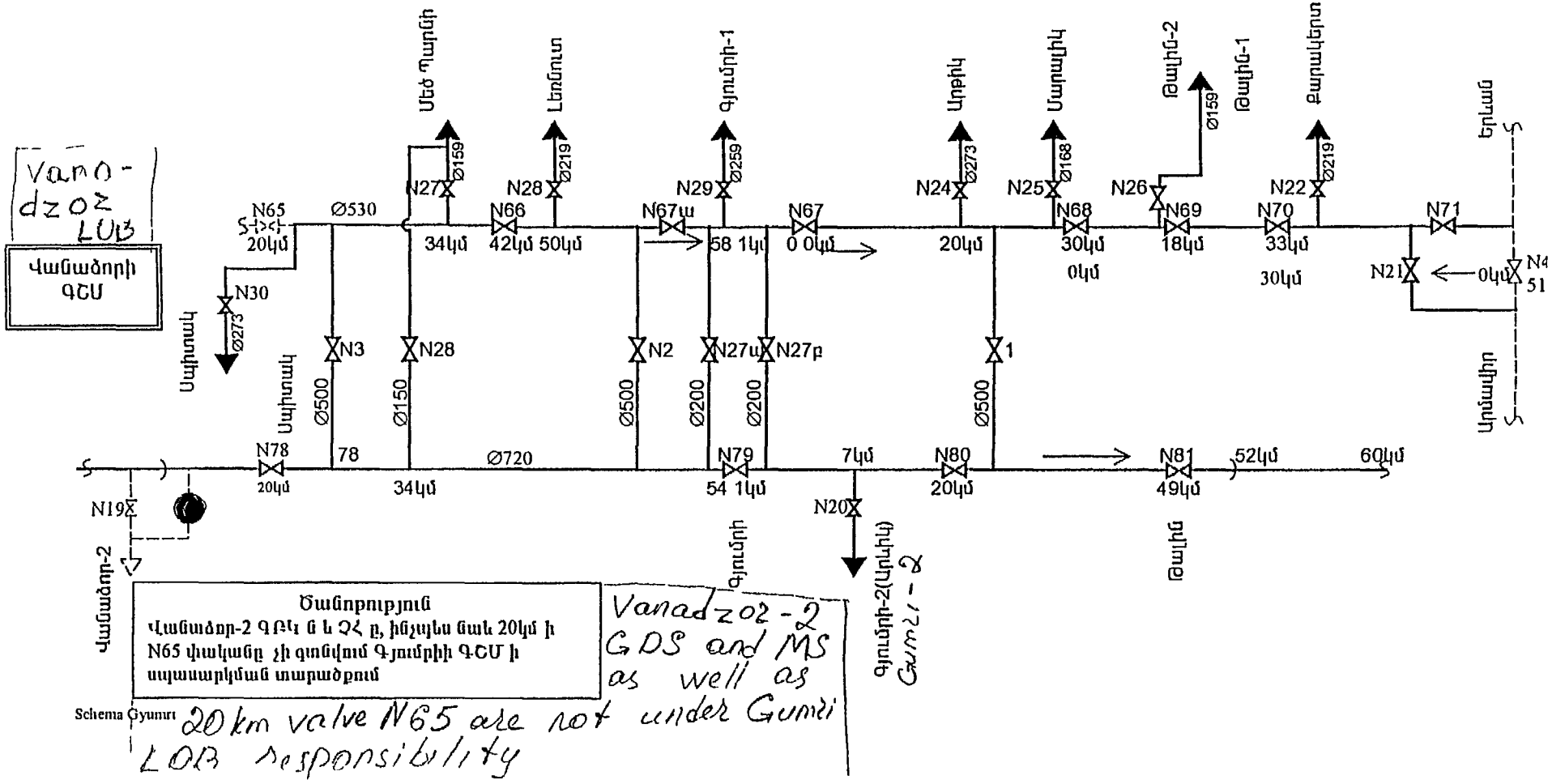

APPENDIX VIII

Gas Pipeline Technological Chart of Martuni Branch

(6)

«Հաստատում եմ»
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

Դաշքենտ _____ Ն Գարրիելյան

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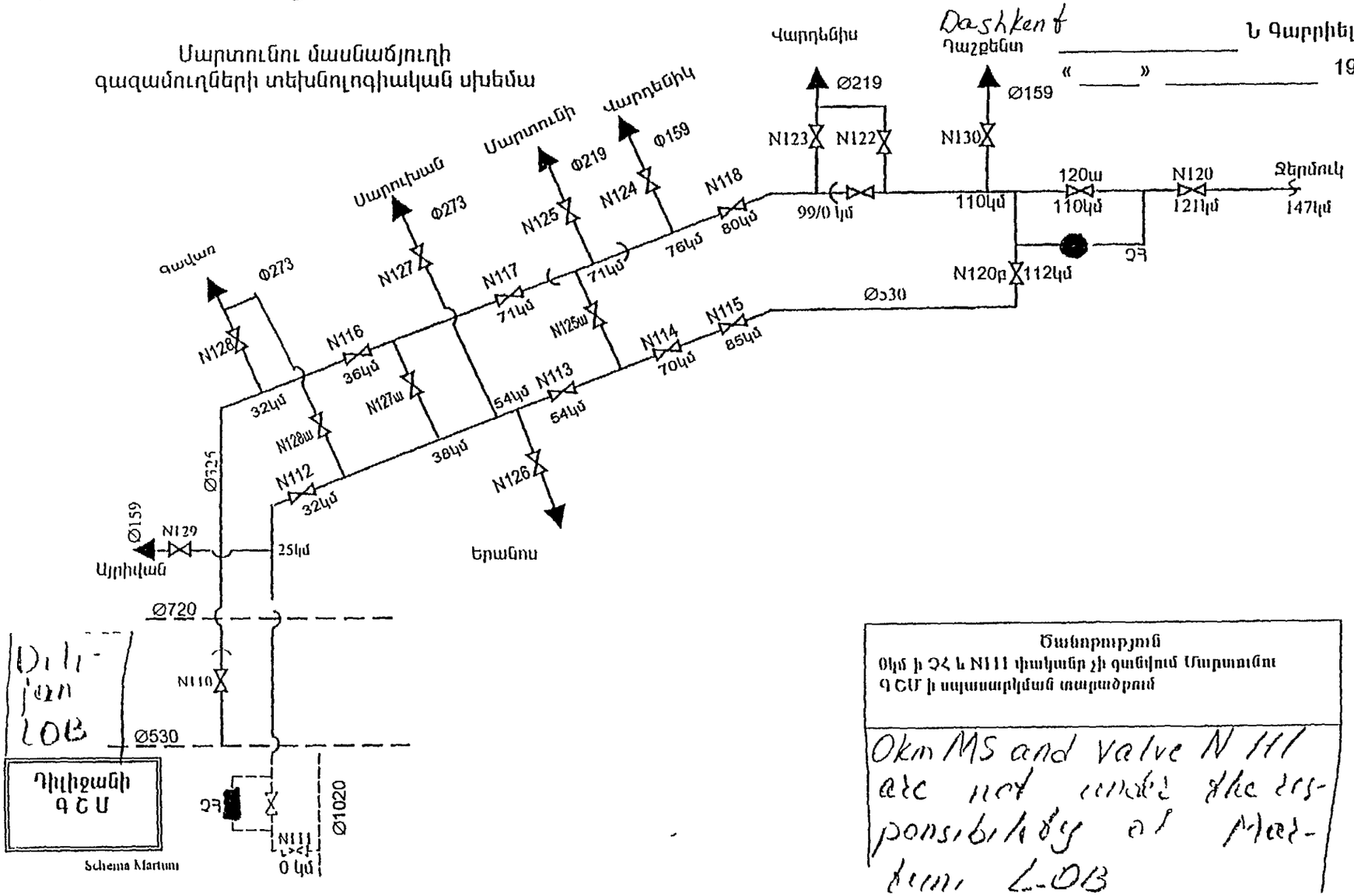
Մարտունու մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա



Ծանոթություն
0կմ ի ՉՀ և N111 փականը չի գանվում Մարտունու ԳՇՄ ի սպասարկման տարածքում

0km MS and valve N 111 are not under the responsibility of Martuni L-OB

Dili-jan LOB

APPENDIX VIII

Gas Pipeline Technological Chart of Goris Branch (7)

Գորիսի մասնաճյուղի
գազամուղների տեխնոլոգիական սխեմա

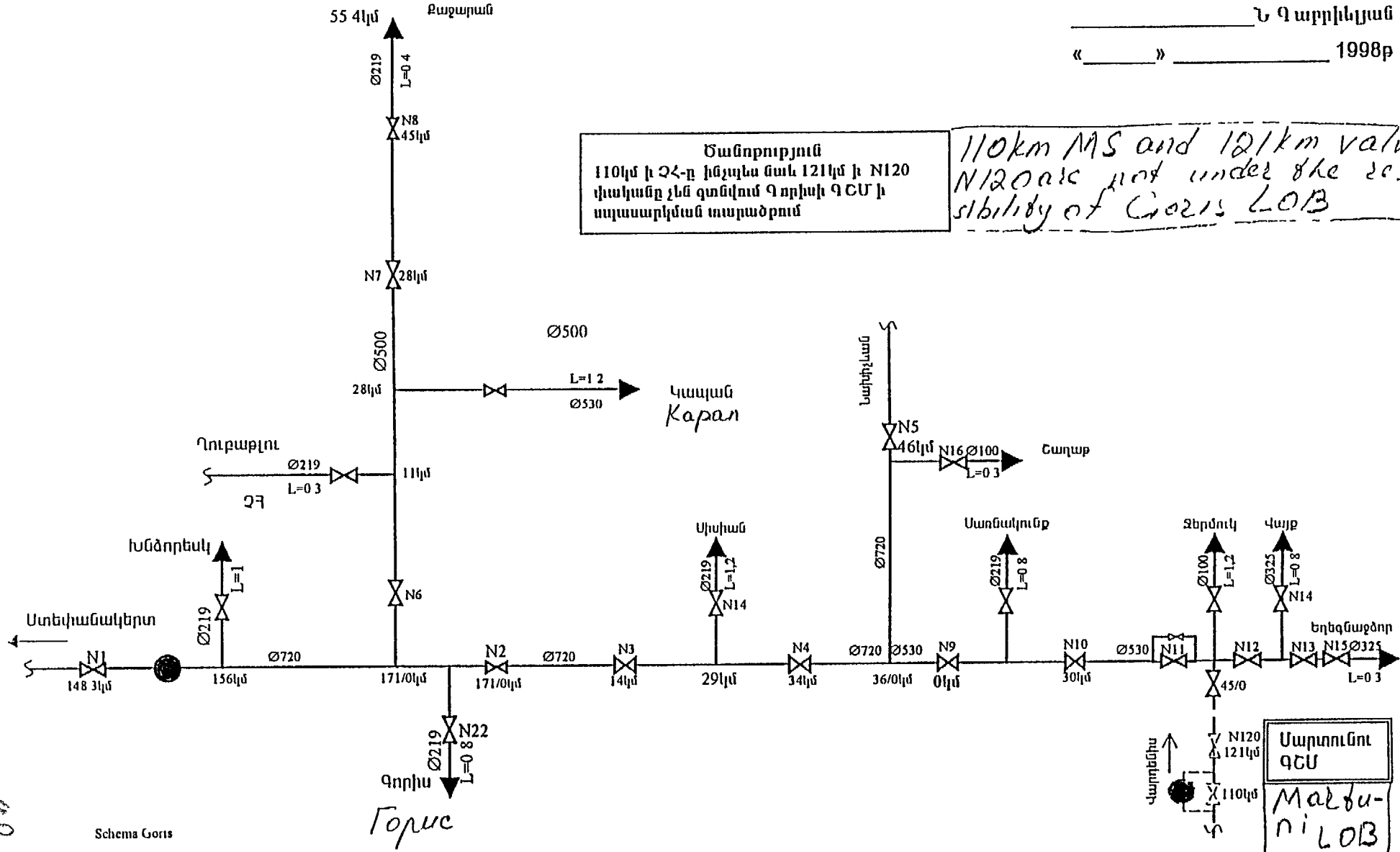
«Հաստատում եմ»
«Հայտրանսգազ» ՊՓԲԸ տնօրեն

_____Ն Գ ասրյանյան

«_____» _____ 1998թ

Ծանոթություն
110կմ և 24-ը ինչպես նաև 121կմ և N120 փականը չեն գտնվում Գորիսի ԳՇՄ և սպասարկման տարածքում

110km MS and 121km valve N120 are not under the responsibility of Goris LOB



Maldu-ni LOB

REPUBLICA OF ARMENIA
MINISTRY OF ENERGY

STATE ENTERPRISE
"ARMTRANSGAS"

ABOVIAN PIPELINE SYSTEM, GAS STORAGE AND TECHNOLOGICAL CONSTRUCTIONS REHABILITATION PROGRAM FOR 1997-2000

YEREVAN 1997 (SEPTEMBER)

1 INTRODUCTION

2. GAS TRANSMISSION SYSTEM

3 DESCRIPTION OF PIPELINES AND TECHNILOGICAL CONSTRUCTIONS TECHNICAL CONDITION

4 GAS TRANSMISSION STATIONS

5 ELECTIC-CHEMICAL PROTECTION INSTALLATION

6 BUILDINGS AND CONSTRUCTIONS

7 TRANSPORTATION MEANS AND MECHANIZMS

8 CONCLUSION

9 PHASE I (1997-1998)

10 PHASE II (1999) PHASE III (2000)

11 GAS STORAGE STATION

12 TABLES -ATTACHMENTS (TECHNICAL CONDITION OF ABOVIAN PIPELINES AND OTHER EQUIPMENT)

13. TABLES -ATTACHMENTS (TECHNICAL CONDITION OF VANADZOR PIPELINES AND OTHER EQUIPMENT)

14. LIST OF TECHNICAL CONDITION OF ABOVIAN BRANCH PIPELINES AND GAS TRANSMISSION SYSTEM ELECTIC-CHEMICAL PROTECTION EQUIPMENT UPTO 01 09 97

15 LIST OF TECHNICAL CONDITION OF VANADZOR BRANCH PIPELINES AND GAS TRANSMISSION SYSTEM ELECTIC-CHEMICAL PROTECTION EQUIPMENT UPTO 01 09 97

16 LIST OF TECHNICAL CONDITION OF GORIS BRANCH PIPELINES AND GAS TRANSMISSION SYSTEM ELECTIC-CHEMICAL PROTECTION EQUIPMENT UPTO 01 09 97

17 PIPELINES SCHEMS

18 ILLUSTRATIONS CHARACTERISING TECHNICAL CONDITION OF PIPELINES

1 Introduction

"Armtransgas" SE is founded by the MOE order N 121 GM dated 01/31/97
"Armtransgas" SE carries out the following main functions,

- Natural gas transmission by gas mainlines
- Natural gas accumulation and storage in underground storage facilities
- Import of liquefied hydrocarbon gas storage in underground and overground storage facilities regasification and supply to consumers
- Gas mainline constructions GDS other gas system facilities, their operation and maintenance
- Gas sector industrial production

Functions carried out by "Armtransgas can be classified according to the following directions

- Gas transmission
- Natural gas storage
- Liquefied gas storage and reallization
- Industrail production
- Construction

II Gas Transmission System (GTS)

The "Armtransgas balance as at 09 01 97 shows

- Gas mainlines – 1918 54km
- Gas distribution stations (GDS) with metering units – 60 st
- Electric protection stations – 139 facilities
- Operators' and observers' houses – 49

Including

a) Abovian gas mainline operation and gas supply branch
- Gas mainline pipes with diameter 1200 – 300mm – 1027km
- GDS with metering units – 32 st
- Electric protection stations – 76
- Operators' and observers' houses – 31

b) Vanadzor gas mainline operation and gas supply branch
- Gas mainline pipes with diameter 1200 – 250mm – 581km
- GDS with metering units – 18 st
- Electric protection stations – 41
- Operators' and observers houses – 12

c) Goris gas mainline operation and gas supply branch
- Gas mainline pipes with diameter 700 – 300mm – 310 5km
- GDS with metering units – 10 st
- Electric protection stations – 22
- Operators and observers houses – 6

III DESCRIPTION OF TECHICAL CONDITIONS OF GAS MAINLINES ANS TECHNOLOGICAL CONSTRUCTIONS INSTALLED THEREON

1 Gas mainlines

Name of Gas pipeline	Diameter	Length	Length of broken-down gas pipeline	Location of broken-down gas pipeline	Cause of failure
1 Abovian gas mainline operation and gas supply branch					
Kazakh-Yerevan	720	138	1000	52–53	Slide
Kazakh-Yerevan	720	138	7000	80–87	Corrosion
Kazakh-Yerevan	720	138	17000	0–8 163–176	Slide Protection area violation Corrosion
Yerevan-Armavir	530	53 4	8000	0–8	Slide place Protection zone violation Corrosion
Yerevan-Ararat	377	37 9	7000	0–7	Corrosion
Ilyichevsk-Yerevan	720	86 6	33000	27–60	Corrosion
Sevan-Vardenis	525	99 1	1000	87–88	Sevan water level drop
Sevan-Vardenis			1000	95–96	Corrosion in turfy environment
Sevan-Vardenis			18000	54–72	Corrosion
1 Vanadzor gas mainline operation and gas supply branch					
Red Bridge-Yerevan	1020	30	500	12 5–13	Insulation dislocation
Red Bridge-Alaverdi	530	55 1	19000	21–40	Corrosion
Vanadzor-Alaverdi	530	42	1000 300 1000	17–18 21–22 36–37	Slide Protection area violation
Vanadzor-alaverdi Dilijan-Alaverdi Vanadzor-Gumri	530 530 530	42 35 4 58 1	20000	Quarter Taron c Vanadzor	Dismantled after earthquake
Vanadzor-Gumri	530	58 1	600 1000	24–25 18–19	Mechanical damages and

					protection area violations
Red Bridge-Alaverdi	720	55 6	9000	21–30	Technologicavi olations corrosion
Vanadzor-Alaverdi	720	39 7	1000	36–37	Protection area violations
Vanadzor-Gumri	720	54 1	1000	18–19	Protection area violations
Vanadzor-Armavir	720	60	11000	49–60	Mechanical damages
				TOTAL	**158 4km**

2 Gas Distribution station (GDS)

Amongst 60 GDS and metering units installed on GTS 16 gas distribution stations have unsatisfactory technical conditions i e

- Missing control-metering devices and automation means
- Physical wear of flowmeters pressure regulators and filters
- Absence of heating lectric supply and communication

3 Electric-chemical protection station (ECPS)
Because of embezzlement no ECPS (amongst 139 stations installed on the system) operates

4 Buildings and structures
17 houses of operators and linear observers (amongst 49 houses) are in emergency conditions Because of heavy rains and road wash-outs access ways to GDS and tap sites became non-passable The repair is necessary

5 Vehicles and Mechanisms

Vehicles and mechanizms provided for gas pipeline maintenance and GDS are in extremely poor conditions Technical specifications of gas pipelines GDS taps ECP units and other structures are given in the Attachments

Conclusion

Taking into account the circumstance the gas mainlines maintained by Abovian and Vanadzor branches are underground their technical status can be defined only after receiving results of diagnostic analysis and test After visual review of GTS carried out by Armtransgas commision 09 01 97 conditions of gas mainlines GDS, ECP and other structures thereon can be evaluated as unsatisfactory
Taking into consideration the above-stated the Rahabilitation Pragram is proposed to be implemented in 3 phases for continuous and safe operation and gas transmission at minimum losses The scale of works for GTS rehabilitation in 3 phases are given below

APPENDIX IX

PHASE 1 (1997 - 1998)

N	Name of works	Unit of Measure	Quantity	Amount in USD
1	Places of gas pipelines to be rehabilitated 1 gas mainline Kazakh0Yerevan 52–53km-1000p/m, 80–87km – 7000p/m Yerevan-Ararat gas pipeline 0–7km – 7000p/m Sevan-Vardenis gas pipeline 87–88km and 95–96km – 2000p/m Red Bridge-Sevan gas pipeline 12–13km – 500p/m Vanadzor-Alaverdi gas pipeline 171–8km, 21–22km 36–37km – 2300p/m Red Bridge-Alaverdi gas pipeline 21–30 – 9000p/m			
2	Drafting of design-estimate documentation	Km	28 8	120 0
3	Rehabilitation of the gas pipeline damaged places noted in § 1	Km	28 8	1780 0
4	Purchase and installation of ECP units	Units	76	360 0
5	Repair of GDS and Metering units	Station	32	64 0
6	Repair of Tap units	Piece	30	600 0
7	Repair of Metering and control-metering devices	Set	45	300 0
8	Repair of Electric equipment and lines			180 0
9	Repair and installation of communication			60 0
10	Repair of mechanisms emergency equipment and vehicles			120 0
11	Repair of operators' and observers' houses	Piece	8	60 0
TOTAL 3644 000 USD				

PHASE 2 (1999) PHASE 3 (2000)

N	Name of Works	Unit of measure	1999		2000		Remarks
			Scale	Amount in USD	Scale	Amount in USD	
ABOVIAN BRANCH							
1	Drafting of design-estimate documentation for rehabilitation of gas pipeline damaged	Km	42	215	31	120	

	places						
2	Repair of gas pipeline	Km	42	8115	31	5800	
3	Cleaning and testing of gas pipelines	Km	200	400	100	200	
4	Purchase and installation of ECP units	Set	76	222			
5	Rehabilitation renewal od GDS gas metering units and purchase of new flowmeters	Piece	32	1320	32	1300	
6	Renewal of taps	Piece	30	350	30	200	
7	Repair of metering and control-metering devices	Set	45	80	45	45	
8	Renewal of electric supply equipment			390		300	
9	Renewal and installation of communication			100		80	
10	Renewal of transport and emergency technique			160		150	
11	Renewal of operators' and observers' houses			60		20	
	VANADZOR BRANCH						
1	Drafting of design-estimate documentation for rehabilitation of gas pipeline damaged places	km	20	130	18	117	
2	Repair of gas pipeline	Km	20	5298	21	5828	
3	Cleaning and testing of gas pipelines	Km	100	170	100	170	
4	Purchase and installation of ECP units	Set	25	112	25	112	
5	Rehabilitation renewal od GDS gas metering units and purchase of new flowmeters	Piece	18	1000			

6	Renewal of taps	Piece	10	250		250	
7	Repair of metering and control-metering devices	set	10	50		50	
8	Renewal of electric supply equipment			150		100	
9	Renewal and installation of communication			35		20	
10	Renewal of transport and emergency technique			21		10	
11	Renewal of operators' and observers' houses			10		5	
	TOTAL			**7226**		**6662**	
			GORIS BRANCH				
1	Purchase and installation of ECP units	Set		18	10	45	
2	Rehabilitation renewal od GDS gas metering units and purchase of new flowmeters	Piece		100	3	160	
3	Renewal of taps	Piece		125	4	100	
4	Repair of metering and control-metering devices	Set		15	4	20	
5	Renewal and installation of communication			4		3	
6	Renewal of transport and emergency technique			3		3	
7	Renewal of operators' and observers houses	piece		2		1	
	TOTAL			**267**		**332**	
	GRAND TOTAL			**18905**		**15209**	

Total amount by phases (1997-2000) is 37 758 mln USD

Including

Phase 1 3 644 mln USD

Phase 2 18 905 mln USD

Phase 3 15 209 mln USD

MINISTRY OF GAS INDUSTRY

STATE GAS INSPECTION

STANDARD INSTRUCTION

HOT OPERATIONS IMPLEMENTATION ON THE EXISTING PIPELINES, GAS COLLECTION SYSTEMS AND GAS STORAGE STATIONS, TRANSPORTING NATURAL GAS

MOSCOW 1971

GENERAL INSTRUCTIONS

1 The following STANDATD INSTRUCTION concerning implementation of hot operations on the existing pipelines, gas collection systems and gas storage stations The instructions are to develop "Main gas pipeline maintenance safety rules (edition 1963)"
2 Hot operations are welding, gas cutting and the other, connected with procedures (flange heating and cutting), produced directly on the operating pipelines, gas collection systems and gas storage stations
3 Standard Instruction is obligatory for all Gas Industry organizations, which are performing hot operations on the pipelines, gas collection systems and gas storage stations, transporting natural gas

Note The additional Instruction (in accordance with specific conditions and features) for hot operation implementation on the pipelines, gas collection systems and gas storage stations is in the process of development and co-ordination with gas inspection now

4 Hot operations implementation on the compressor and gas transmission stations, technological facilities must be provided in accordance with "Gas mainline operation safety rules", "Compressor stations equipment installation on the mainline safety rules", "Oil and gas producing industries safety rules" in force
5 Hot operations on the gas supply systems of villages, houses of linear repairs and operators of gas transmission stations must be provide in accordance with "Gas economy safety rules" in force
6 This Instruction also developed for hot operations implementation during pipelines, gas collection systems and gas storage stations blowing and testing
7 Hot operations can be planned and emergency Planned hot operations implementation must be provided in accordance with the terms of renovation schedule Emergency hot operations implementation must be provide immediately after emergency detection Gas inspection must be immediately informed about the emergencies on the pipelines In the cases of accidents and traumas the Trade Union Technical Inspector must be informed about it
8 All hot and rehabilitation works, connected with pipelines, technological facilities, compressor and gas transmission stations operation suspension must be coordinated with General Board of Main Gas Pipelines and Gas Production Main Board
9 Pipelines Maintenance General Board or Union gives the Orders for hot operations (planned and emergency) performance and appointment of supervision for these works performance General Board or Union in accordance with the scope and technical complexity of the works can give the permission for these works performance and appoint the supervision of hot operations implementation
10 Head of Linear Operation Station, Chief Engineers of General Boards and Unions can be appointed as a responsible persons for these operations implementation In all cases, the operations and resources use must be coordinated with the person responsible for hot works performance

11 Responsible persons for hot operations performance in the process of pipelines blowing and gas testing (liquidation of cracks, holes, erosions) in accordance with scope and complexity of the works Head of sections, Chief engineers, Heads of welding-installation companies can be appointed as a responsible for installation works or blowing and gas testing on the same pipeline The permission and order for the hot works performance is issued by Senior welding-installation organization

12 In accordance with the Plan of Works organization and performance the Head of hot operations provision is responsible for hot operations implementation management and for their safety

13 Welding can be performed by the electric and gas welders, passed the examinations according to the "Electric welders test rules"

14 Workers, passed the accidents liquidation test can participate in the hot works performance Before hot works starting Head of the hot operations performance must instruct the whole staff about accident prevention during the works performance After it, every employee, who passed the course, must sign in the log of instructions

15 Planned hot operations are performing according to the plan and schedule approved by the Head of Board, Head of Linear Operation Station, Head and Chief Engineer of Pipelines Maintenance Board or Union In each case, when there is a problem (swamp, hard-to-reach, underwater and over water parts, rocks, units of compressor stations, operations on the several parts of the pipeline at the same time or operations on the parallel lines) hot works performance must be approved by Mainlines Maintenance Board in CO-ordination with Gas Inspection

16 The plan of emergency hot operations can be developed, using the requirements of the Instruction concerning hot operations organization and plan of their implementation, by the Head of the hot operations on the site of emergency

17 Plan of organization and hot operations performance includes

a) pipeline name, place of hot operation performance, date and time of these operation beginning and completion, list of the works in it's production sequence, consumer gas supply problem solution for the period of works performance,
b) placement of the protection stations and facilities, communication means, list of involved in these works personnel (name, position, etc),
c) order and sequence of connections and disconnections on the linear part of pipelines, pipelines communications, means of automatic and electric-chemical safety,
d) Detailed scheme of the part of pipeline, where hot works must be performed
e) scope and type of the preliminary works
f) Repaired pipeline testing
g) team personnel, which is going to perform hot works on site, main and additional means
h) accident prevention and fire-fighting means

18 Supervisor for hot works performance, Duty Dispatcher of General Department must have the scheme and the plan for such measures provision According to mutual agreement, one copy of the scheme and plan must be given to Gas Inspection

Personnel, involved in hot operations performance must be familiarized with scheme and plan

19 Supervisor must receive special permission before hot works performance The following information must be included in such permission

a) date and time of works beginning and completion
b) name of Head, responsible for works implementation
c) team staff (specialties, surnames, initials)
d) character of the work (in the case of necessity schemes and sketches must be attached)
e) conditions of work, safety means, instructions

Permission must be signed by the Director of the Organization, who signs the Order for hot operations performance and gives it to Supervisor, who is responsible for such works performance

Head of the Organization, who signs the Order concerning hot operations performance must have 1 copy of the Permission, and the other copy must be given to the Responsible Director

In the cases of introducing modifications into work scope and their nature or in the case of party change in the process of the hot works performance new additional permission for further works implementation must be given and corresponding corrections must be made in the scheme and plan (Attachment)

20 Preparation for the planned hot operations implementation (excavations, installation units preparation and their mobilization to the site, tubes, derrick-cranes, construction equipment haulage, temporal garage for transportation and construction of temporary road for auto transport and construction materials) In the process of emergency for hot operations performance, above mentioned preparations must be implemented according to the Responsible Director order, taking into account the Emergency Liquidation Plan

21 Responsible Director must provide required tools, equipment, materials, communication, safety means, first aid kits, connection with health clinics

22 Before hot works performance technical condition of block valves must be inspected Special lubricant must be used for sealing system

23 In process of hot works performance valve must be opened and closed on the instruction of Supervisor, responsible for hot works performance

24 All orders from Senior organizations, concerning hot operations performance must be passed via Supervisor for hot works performance

25 Hot works on the mainlines and gas collector systems must be performed in case of 20 – 50 mm water column, gas pressure measurement must be checked by V-shaped manometers, installed on the disconnection device located on the site The gauge must be under continuous control to prevent gas pressure increase or discharge in the pipeline vacuum Duty responsible person is appointed and

appropriate communication means must be used near valves on the sites, foreseen for repair

26 Disconnection devices in the process of gas exhausting must be opened gradually and smoothly Personnel not involved in the gas exhausting activity, all transportation means and mechanisms must be replaced out of the pipeline safety area, not far from 150 m from pipeline axle

27 Gas exhaustion through flanges clearance is prohibited

28 The site, foreseen for hot operations performance must have reliable telephone and radio lines with duty dispatcher of District Department and with all points, created for pipeline disconnection devices maintenance, (gas pressure, etc)

EXCAVATION WORKS

29 It is necessary to dig pits to clarify pipeline depth before excavation works performance

30 Pits and ditches excavation by machines on the pipelines under the pressure, which has no leakages must be performed on the distance of 0 5 m from pipeline The excavation works at the distance less than 0 5 m from pipeline must be performed by hand, taking into account safety rules which exclude pipeline damage

Note Pits and ditches excavation on the pipelines, from which gas is released, must be implemented by means of excavation machines, according to safety rules which exclude pipeline damage

31 In the case of gas leakage from the acting pipeline, it is required to reduce gas pressure before excavation works starting Gas pressure must be reduced depending on the leakage size, but not less than 30% of the max pressure, standard for this part of pipeline Excavation machines use is prohibited

32 Excavation works on the operating pipeline with great gas leakage following with outburst are permitted only after gas pipeline sector fully discharge

33 The size of ditch or trench must be determined according to the hot operations character Depth and width of the ditch or trench must be big enough for performing electric and gas welding, isolation works and to provide free access for further welding joints exposure

34 The ditch must have two convenient exits in contrary directions

35 In the case of ground water, flow to it is necessary to provide pumping works places for water collection and pumping In the case of marsh-land and floating earth the excavation works must be performed by piling construction or other devices installation in order to prevent the water coming to the place of work and ditch walls landfall

STOPPERS INSTALLATION

36 Stoppers are used to block the section where hot works are performed for coils, bends and block valves cutting Before rubber balloons installation is required to

check their integrity on site Stoppers installation after guarantee term expire is prohibited

37 Stoppers must be installed on the distance not less than 6 m on the both sides of the site, foreseen for hot works performance

38 Before stoppers installation gas pressure in the pipeline must be checked by V-shaped gauge, installed on the disconnection device and on the site of works performance V-shaped gauge is connected to the pipeline by means of rubber tube with the help of special cone nipple, compressed in the hole (diameter of 6 – 8 mm), drilled in the upper part of the pipeline

39 After V-shaped gauge installation and gas pressure checking, it is necessary to cut two oval shaped holes for stoppers installation Hole size must be not more than 250 x 350 mm and the hole width must not exceed the half of pipeline diameter Hole minimum size must be 100 x 150 mm

40 Stoppers must be protected by fireproof material and must be installed on the pipeline released from condensate, between the hole for stopper installation and site for hot operations performance

41 Stopper, placed in the pipeline must be pumped to achieve the pressure 400-500 mm of water column Stopper must be snug to the pipe During hot works performance stopper state must be under continuous control

42 It is allowed to use permanent clay plugs (which are used with stoppers) where hot works are performed on the pipelines with diameter up to 300 mm

43 In case of pipeline emergency, when gas pipeline is fully discharged, it is necessary to blow air (pressure 1 atm) into disconnected sector before holes cutting and stoppers installation Air mixture is directed from two sides of the blow-out point Content of oxygen must be not more than 2%, according to the gas analyzer reading

WELDING-ASSEMBLAGE WORKS

44 Only prefabricated connection details (T-joints, elbows and reducers) should be generally applied during planned and emergency hot works

While emergency liquidation it is allowed to apply connection details manufactured in repair bases or in field conditions in accordance with the acting norms defined by Ministry of Gas Industry

400mm (and more) connection details, made by welding in repair bases or in field conditions, should be made of pipes with wall thickness, applied for I and II category gas pipeline sections

Connection details' welds should have internal back-up weld and be gamma-rayed and X-rayed

Assemblage units should be made in accordance wit the norms defined by Ministry of Gas Industry

45 Before works, related to gas pipeline disconnection, it is necessary to install jumpers with section not less than 25mm^2 at the disconnection point This pursues the aim of preventing spark formation because of stray current Cathodic protection stations and drainage facilities are switched off

46 In case gas pipeline hot works are performed at a close distance from a disconnecting device, precautions should be taken for a contingent gas heating by flame

47 Welded point must be protected from atmospheric precipitations and wind

48 During hot works it is permitted to weld joint by several welders simultaneously, and each welder should impress its own brand, on DU-40 pipelines – with non-washable paint

49 Pipe joints welding and assemblage should be done in accordance with the technology, specified in the ratified normative documents which take into account the type of steel, air temperature

50 Pipes with one or two precast longtitudinal seams are assembled in such a way that longtitudinal seams of each pipe will be dislocated in respect to the seams of adjacent pipes no more than by 100mm

51 While pipe assembling the clearance between edges should be even throughout all the perimeter of the seam For pipes whose walls have thickness up to 8mm the clearance size should be 2 0 – 3 0mm, for pipes with thickness 8– 10 mm – 2 5–3 5, for walls with thickness 11mm and more - 3 0–3 5 The dislocation of edges is allowed not more than by 25% of pipe wall thickness (the minimum of the weldable ones) on the location of not more than1/4 of the circle length The pipe assemblage should be done with application of surface aligners

52 While pipes' joint assembling dislocation of edges on the bottom ceiling part of the joint is not allowed Correction of pipe edges or spacing of "lips" is allowed to be done by means of padding only in the upper half of joint The pipe padding is done in hot conditions with heating not less than 300^{0}C

53 Winter welding works at the air temperature less than 0^{0}C should be perfor med with the preliminary heating of the edges to be welded up to 100-150^{0}C The temperature is defined by a thermal pencil or thermal paint

54 Welding seams should have no cracks, burn-throughs, cuts with depth more than 0,5mm and misalignments Seam reinforcement should be even with height within 1-3mm

55 Upon finishing of welding the seam should be closed by an asbestos belt for gradual cooling

56 Welding joints on tacks or first layer welding seams are not allowed to be left unfinished

57 All the welding connections, including "patch" in-welding seams, made in the process of pipeline repair-rehabilitation works, are subject to inspection by gamma-raying or X-raying

IN-WELDING OF BOBBINS AND VALVES

58 Bobbins and valves are allowed to be welded into pipeline only using backing rings made of steel stripe with width 40-50mm and thickness 3-4mm

59 The length of bobbins should be not more than 500mm for pipes with diameter up to 500mm, and for pipes with large diameter – not less than pipe diameter

60 While replacing linear valve a high-thickness wall branch pipe (length – not more than specified in article 59) is in-welded between valve and pipeline

TAP ASSEMBLY

61 Tap assembly into the functioning pipeline is done in the following ways

a) a prefabricated or technologically made (in accordance with article 44) t-joint in-welding

b) cutting an opening and branch pipe welding inserting the latter inside the pipeline for 3–5mm

500 mm branch pipe should be in-welded with seam root internal back-up weld Edges of pipe opening should be cut at the angle 60^0 The clerance size should not exceed 3mm After branch pipe in-welding a reinforcement strap is installed The branch pipe should be made of pipes with wall thickness not more than thickness of pipeline wall The variance of the pipeline diameter and in-welded branch pipe diameter should be not less than 200mm In case of less variance a T-joint should be in-welded

62 Branch pipe and T-joint welding for branchings on curve parts of the pipeline and circumferential and longtitudinal prefabricated welding seams locations is forbidden Distance between circumferential and longtitudinal weld and branch pipe weld should be not less than 100mm

Remarks in exclusive cases branch pipe in-welding is allowed on spirale welds with further gamma-raying The length of prefabricated weld section to be gamma-rayed should be not less than 300mm from each side of external wall of the in-welded branch pipe

The existence of cracks of any size and incomplete root penetration by more than 10% of the wall thickness in controllable locations is not allowed

REPAIR OF WELDING JOINTS

63 Repair of welding joints by means of cutting and welding-up defective points is allowed in the following cases

a) if summary length of defective points does not exceed 1/4 of the joint length
b) if length of cracks revealed in the joint does not exceed 50mm

64 Cracks with length 50mm are drilled by a 5mm drill on the ends, the metal along the crack is cut out forming a bevel, cleaned thoroughly and welded by several layers While cutting it is necessary to go behind crack edges not less than by 30mm from each side

65 All the repaired joint locations should be tested by gamma-raying or X-raying

66 In case the summary length of defective points exceeds 1/4 of the joint length joints are to be removed

67 The pipe section with a crack on longtitudinal prefabricated weld, facing the circumferential weld, should be replaced by means of bobbin installation

68 In case of discovering a lap or delamination in pipe the whole pipe is to be replaced

IN-WELDING OF PATCH

69 Repair of gas pipeline by means of patch in-welding is allowed for pipes with diameter more than 219 mm Patch sizes should not exceed 250x350mm, herewith patch width should not exceed half of pipeline diameter The minimum size of patch should be100x150mm The variance of width and length of patches should be not less than 50mm The cut opening made for a patch should have oval form The patch should be made of the same metal as the pipe to be repaired The preparation of patch should be done according to sampler, patch edges should be cleaned in mechanical way with a bevel of 25-30^0

70 Patch should be in-welded on a backing ring The backing ring in the form of a sheet metal stripe with thickness 3-4mm is fastened to the pipe or the patch so as backing plate edge overlaps the opening edge and patch edge by 10–12mm Herewith the backing plate should be pressed as to the patch so to the type The clearance between the pipe and the patch should be within 2–3,5mm

71 The 12mm thickness patch, installed in pipe opening, should be welded in three layers in junction The weld root should be made by electrode with diameter 3mm, and the second and other layers – with diameter 3-4mm

72 The patch joint seam should be welded by a reverse-stepwise method, in 3-4 steps Patch is forbidden to put in overlap

WELDING OF STOPPERS

73 It is allowed to install only spherical stoppers on gas pipelines, they should be welded together by their protruding part directed towards outside

74 Home-made stoppers are forbidden to be installed

75 In case a prefabricated spherical stopper of the required diameter is missing, it is allowed to use analogous stoppers with less diameter with a conic reducer The conic reducer is manufactured of not less than 5-8 tabs on condition that minimum width of the tab should be 100mm Welds, connecting the tabs, should be double-sided with full penetration of the whole wall thickness, they should be controlled by gamma-raying or X-raying

PIPE REPAIR ON OPERATING GAS PIPELINE

76 Steel pipe (with bottom ultimate strength up to 54kg/mm^2) repair

a) scratches, scores and holes (with depth to 30% of wall thickness) discovered on pipes are allowed to be repaired by means of repair Herewith, pipes having not more than 5 scratches or scores up to 600mm and situated at distance not less than 500km form each other, are allowed to be repaired The on-welding minimum length should be not less than 70mm Pipes, having scores with depth not more than 0,5mm, do not have to be repaired

b) Separate holes or cavities are fixed by on-welding and ground flush with the the pipe surface

c) If holes or cavties have depth more than 50% of wall thickness such pipes or their sections are to be cut out or replaced

77 Steel pipe (with ultimate strength above 54kg/mm^2) repair

a) pipe surface repair by welding is not allowed

b) defects in the form of scratches, scores and separate holes with depth not more tham 0,5mm are allowed to be left unfixed

c) specified defects with depth to 1,5mm and length not more than 200mm are allowed to be fixed by grinding

d) if defect depth exceeds 1,5mm defective parts should be cut out and replaced with bobbins

78 Pipe sections which have cumulus of holes in the form of a entire net should be cut out and replaced with bobbins, irrespective of their depth and sizes

79 Pipes with separate flexible hollows with depth not exceeding wall thickness can be left unfixed If hollow depth exceeds wall thickness, or hollow has sharp edges, then such parts are to be cut out or replaced

80 Hollow length in any direction should not exceed the half of pipe diameter

81 Pipe sections, having holes, scratches or scores at hollow places, irrespective of depth and length, should be cut out or replaced with bobbins

82 Emergency store pipes, used during hot works, should have no defects, exceeding requirements and are not to be repaired

INSULATION, COVERING AND TESTING

83 After positive results of welding connections inspection the repaired gas pipeline section is cleaned and insulated

The anticorrosion insulation, specified by the project for the section to be repaired, is applied

84 After insulation is applied soil under pipe is padded and rammed Pipeline covering with fine sand which excludes damage of insulation coating After covering there should be a roller over gas pipeline

85 After hot, insulation and digging works gas-air mixture is displaced from the switched gas pipeline section by gas with pressure not more than 1kg/cm^2 at the place of its injection The displacement is considered to be finished when oxygen content in outgoing gas is not more than 2% according to gas-analyser

86 After covering the repaired section is tested for maximum operating passage pressure for the given section (for 2 hours) during gas pipeline sections

87 The repair works are presented in the act which reflects steel type and range of installed pipes, welding and insulation quality, test results, welders' surnames, person who authorized pipeline operation after repair and test

SAFETY ENGINEERING

88 Hot works are to be started only after order by Head of Works and confirmation of gas release from the repaired part

89 While repairing it is forbidden to increase pressure in lines parallel to the repaired one, and also in adjacent sections of the repaired pipeline In case valves for switching out the repaired section are impossible to be closed tightly, adjacent valves should be closed and gas should be released In case of parallel lines gas leakage (as a result of corrosion or other cause) discovery during repair or hot works, parallel lines should be completely released of gas and pressure should be reduced not more than by 30% by the first moment of adjacent line repair

90 Emergency vehicles, mechanisms and communictaion should be located from non-wind side Vehicles and mechanisms should be located in such a way that there should be an opportunity of speedy movement and manouvres of all the transportation devices simultaneously and separately

91 All the technical devices, vehicles, mechanisms and staff which takes no part in works should be situated out of the forbidden zone Before starting hot works posts should be established within the radius of the forbidden zone

92 Gas pipeline hot works are allowed to perform round-day While performing hot works at dusky time the site should be illuminated in accordance with requirements SN 245-65

93 In case of thunderstorm gas release, welding-assemblage works, location of people nearby linear valves, gas vents and open gas pipeline is forbidden

94 While performing works the foundation pit may be occupied only by those employees who are particularly engaged in repair at the given time Unnecessary tools, materials and devices are forbidden to keep in the foundation pit

95 Workers participating in hot works should wear corresponding working clothes Repair without working clothes and boots is strictly banned

96 Acetylene generator or liquefied gas balloons, as well as oxygen balloons are placed outside the foundation pit at the distance not less than 10m from it towards highway

97 Before and periodically in the course of hot works air gas saturation in the foundation pit should be inspected This is done by gas-analyser Gas content in air should not exceed 1% by volume

98 Insulation coating is removed to prevent burning of pipeline insulation coating at the sections adjoining the hot works site

99 While cutting pipeline, combustible gas should be ceased (by means of coating slot with wet clay) as cutter moves along the cutting line Upon completion of cutting burning gas flame should be completely extinguished

100 In all cases before starting hot works on operating pipelines and gas collection facilities and after gas release the pipeline is inspected for condensate or petroleum products content and the contingency of their reaching the site of hot works During planned hot works (crack, pocket liquidation, joining up of

tabs, installation of additional stop valves) an opening is drilled in the upper part of pipe by an arm-drill at the scheduled hot works site and water existence is checked by a dip stick In case gas condensate is discovered in gas pipeline or petroleum products an opening is cut in the upper part of pipe for intake pump hose by which liquid is injected into a separate tank A small amount of liquid is allowed to remove from pipeline by buckets, ladles The required fire extinguishing means should be brought in commission during the mentioned works After condensate removal rubber inflatable balloons (stopper) are inserted in accordance with article 37 of the present instruction In case of high condensate or petroleum content in pipeline that section is to be blown by gas prior to hot works until the liquid is completely removed from the pipe

101 If during welding or gas cutting gas ignites inside the pipe (flame skip) or gas burns with high flamewhich prevents hot works, the works should be ceased, workers - evacuated from the pit, burning gas – extinguished by felt or other material Gas ignition inside the pipe or high flame at the hot works site are possible in case of damage or non-air-proofness of stoppers, as well as their blow-out in case of pipeline high pressure or as a result of gas leakage out of linear switching valve Welding and cutting works may be re-started only after liquidation of discovered troubles and recovery of the initial gas pressure in the pipe (20–50 mm) If manometer shows discharge, the repaired section should be blown by gas for gas-air mixture formation prevention and displacement of already formed gas-air mixture from the pipeline Anyway, before hot works the repaired section should be blown by gas for displacement of gas-air mixture which can be formed as at the moment of blow-out so in the course of preparation works

102 Hot works are forbidden in case of condensate and petroleum content in pit Hot works are to be performed only after removing mentioned substances and soil saturated with these liquids from the pit

103 In case gas pipeline has prerequisites for pyrophore iron formation on the internal surface, measures should be observed against its self-ignition resulted from air contact or gas-air mixture The hole formed during pipe cutting should be stopped with with wet clay after the movement of the cutter After cutting the cut out part should be immediately removed from the pit and the internal part of the pipe should be amply watered The crust extracted from the pipe, which contained pyrophore iron, should be collected and buried

104 While testing the repaired part all the staff, mechanisms and vehicles are evacuated from the site out of forbidden zone, dependent upon pipeline diameter Posts should be established within the radius of the forbidden zone for the test period

105 During gas dangerous works in wells, pits and trenches, where there is a suffocation and poisoning threat, all the workers should wear hose gas masks and be provided with safety belts The hose ends should be placed outside the pit or well To observe workers and render first aid at least two workeers should be situated near the pit The ends of safety belt ropes should be held by the observing workers

TECHNICAL DOCUMENTATION

106 After hot works all the amendments to executive technical documentation and charts are made within 3 days The technical department of the Regional Board uses that documentation

107 A technical act on liquidation of defect not related to emergency (holes, cracks) is drawn by Regional Board and sent to the above organizaiton and District Gas Inspectorate within 5 days

108 In case of emergency cause investigation and liquidation act is drawn by the commission assigned by the Ministry dependent upon the complexity of the emergency A representative of the State Gas Inspectorate is appointed the Cheirman of the Commission

Accidents with numerous fatalities and serious injures are investigated by a trade union technical inspector jointly with State Gas Inspectorate employees

APPENDIX X

MINISTRY OF GAS INDUSTRY

Name of Responsible Department/Enterprise_____

Name of Regional Board _____

AUTHORIZATION
for gas dangerous (hot) works

_____
(site of hot works)

_____

Works start "____" hour "___" min "___"_____199___

Works end "____" hour "___" min "___"_____199___

Responsible Head of works_____
(position, surname, initials)

List of Team (profession, surname and initials of each team member)

_____

_____

_____

Guarantees to perform the following works

_____

_____

Remarks If necessary a sketch or drawing is attached Conditions of work performance and precautions (to mention the conditions on which the work shall be performed, specific precautions, protection means and instructions to be governed by)

_____

_____

Authorization issued by _____
(position, family, initials)

"___"_____199__ _____
(signature)

Responsible Head of Works received the Authorization _____
(signature)

"____"_____ 199__

APPENDIX XI

Հաստատում եմ
«Հայտրանսգազ» ՊՓԲԸ
գործադիր տնօրենի տեղակալ
_____ Յու Զիլավյան
«____» _____ 1998թ

Ա Կ Տ

14 08 98թ

Մենք ներքոստորագրողներս, «Հայտրանսգազ» ՊՓԲԸ արտադրաշահագործման վարչության պետ Գ Մկրտչյանը, 1-ին կարգի ինժեներ Ա Պապիկյանը, դիսպետչերական բաժնի պետ Ա Բայրամյանը, Դիլիջանի ԳՇՄ տնօրեն Ռ Սանթրոսյանը տնօրենի տեղակալ Ս Թումանյանը կազմեցինք սույն ակտը հետևյալի մասին

Ս թ օգոստոսի 4-ի ժամը 12-ին Իջևան-Բերդ-Սևան ∅ 1020 մմ գազատարի 36 կմ-ում տեղի է ունեցել գազի արտահոսք և հրդեհ, որը շարունակվել է մինչև ս թ օգոստոսի 10-ը (132 ժամ)

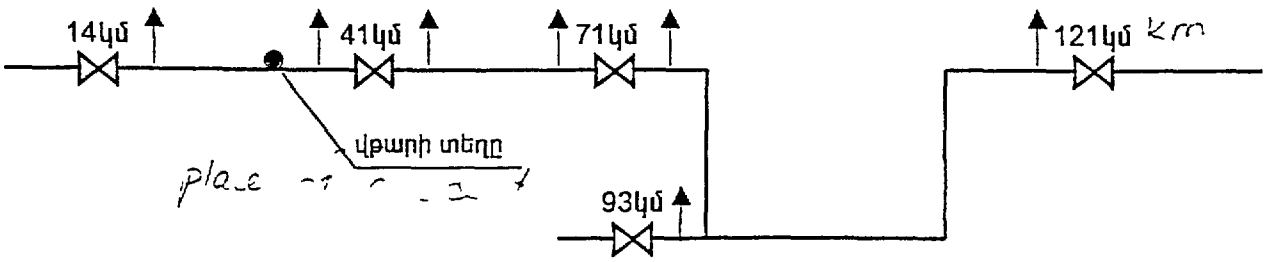
Գազի միջին ճնշումը այդ օրերին կազմել է P=13 8 մթն

Գազի արտահոսքը տեղի է ունեցել կոնդենսատի հեռացման մոմից (D=25մմ տրամագիր փականից S=491 մմ^2) ինչպես նաև հրդեհի պատճառով առաջացած ճեղքից (S=887 մմ^2)

Գազի կորուստը, համաձայն կից ներկայացվող մեթոդիկայի, կազմում է 2236 հազ մ^3

Ս թ օգոստոսի 10-ին Դիլիջանի ԳՇՄ-ի կողմից փակվել է Իջևան - Բերդ - Սևան ∅ 1020 մմ գազատարի 14 կմ-ի և Ղազախ-Երևան ∅ 1020 մմ գազատարի 93 կմ-ի փականները (41 և 71 կմ-երի փականների հերմետիկությունը չի ապահովվում) Իջևան-Բերդ-Սևան ∅ 1020 մմ գազատարի մեջ եղած գազի քանակությունը օգտագործելով Հրազդանի ՋԷԿ-ի սնուցման համար, գազի ճնշումը 14 6 կգ/ սմ ^{2}-ից իջեցվել է մինչև 5 2 կգ/ սմ ^{2} Րրից հետո փակվել է Ղազախ-Երևան ∅ 1020 մմ գազատարի 121 կմ-ի փականը

Իջևան-Բերդ-Սևան գազատարի 14-71 կմ-ը (57 կմ) և Ղազախ-Երևան գազատարի 93-121 կմ-ը (28 կմ) սահմանափակված հատվածը P=5 2 կգ/ սմ^2 ճնշման տակ գազը արտամղվել է մթնոլորտ



Արտամղված գազի քանակը կազմում է

85կմ x 0 785 x 5 2 = 347 հազ խ մ

Գազի ընդհանուր կորուստը կազմում է

2236+347=2583 հազ խ մ

Գ Մկրտչյան

Ռ Սանթրոսյան

Ա Պապիկյան

Ս Թումանյան

Ա Բայրամյան

APPENDIX XI

"APPROVED"
"ARMTRANSGAS" SCJSC
DEPUTY EXECUTIVE DIRECTOR
_____ Yu JILAVIAN
"___" _____ 1998

A C T

We the undersigned Head of Production-Operation Department of ' Armtransgas G Mkrtchian I-st grade engineer A Papikian, Head of Dispatch Department A Bairamian Director of Dilijan LOB R Santrosian Deputy Director A Tumanian have drawn up the present act on the following

On the 36-th km ot Ijevan-Berd-Sevan 1020mm gas pipeline a gas leakage and fire occurred August 4 1998 and continued up to August 10 (132 hours)

The average gas pressure on these days was P=13 8 atm

The leakage was a result of condensate removing vent (D=25mm valve D=491mm^2) and rupture occurred from fire (D=887mm^2)

Gas loss according to the attached methodology is 2236 000 m^3

Dilijan LOB closed 14-th km valve of Ijevan-Berd-Sevan 1020 mm pipeline and 93-rd km valve of Khazakh-Yerevan 1020mm pipeline (41-st and 71-st km valves leak-proofness is not ensured) By using the amount of gas existing in Ijevan-Berd-Sevan 1020mm gas pipeline for Hrazdan TPP the pressure was reduced from 14 6 kg/cm^2 to 5 2 kg/cm^2 Afterwards 121-st km valve of Khazakh-Yerevan 1020 mm gas pipeline was closed

From the restricted segment within the 14-th and 71-st km (57km) of Ijevan-Berd-Sevan gas pipeline and limited segment within the 93-rd – 121-st (28km) gas was released into atmosphere at the pressure of P=5 2 kg/cm^2

The amount of the released gas is

$$85\text{km} \times 0\ 785 \times 5\ 2 = 347\ 000\ \text{m}^3$$

Total gas loss is

$$2236+347=2583\ 000\text{m}^3$$

G Mkrtchian
A Papikian
A Bairamian

R Santrosian
S Tumanian

APPENDIX XII

Plan for organization and performance of hot works on the existing operating pipeline

1	Name of the sector	Khazakh- Yerevan
2	Responsible supervisor	Head of Gas maintenance department(LOB) Hajrapetian
3	Site for hot works provision	Khazakh-Yerevan pipeline 109 km
4	Type of hot works , foreseen for performance	Metering equipment installation
5	Time for works performance Begin----------end----------	8 00 22 00
6	Gas supply in the process of works performance	Gas supply is not terminated
7	Line valves are blocked in the process of works performance	Khazakh- Yerevan 93 kmN7,141km, N10,121km N59and 60, Sevan-Vardenis 0 kmN111
8	Gas is released from pipeline gas vents	Khazakh-Yerevan 93,96,121,141km,Khazakh-Berd-Sevan 41and 71km
9	Sector diagram is attached	Khazakh-Yerevan D=1020 Technology diagram for meter , installed on 109 km ,is attached

APPENDIX XII

`Preliminary works performance

N	Works type	Works begin	Works end	Quantity	Used equipment and devices	Position	Name, surname	Responsible supervisor
1	2	3	4	5	6	7	8	9
1	To present the information about performed scope of works	8 00	8 30		According to regulations	Gas maintenance department deputy director Engineer	Tadevossian Balasanjan	Hajrapetian
2	Mechanisms , equipment, instruments loading on trucks for their mobilization	9 00	10 00		Trucks	LOB deputy director Senior master Person in charge	Tadevossian Vardanian Terian	Hajrapetian
3	Works displacement to different Place point N1 pointN2 pointN3	9 00	10 30		Trucks	Drivers	Margarian Movsisjan Tadevossian	Hajrapetian
4	Mechanizms, equipment mobilization, unloading in corresponding points	10 30	12 00		Trucks	Person in charge „-„ „-„ „-„	Terian Antonian Tadevossian Movsissian Hovhanissian	Hajrapetutian

APPENDIX XII

	Works type	Works begin	Works end	Quantity	Used equipment and devices	Position	Name, surname	Responsible supervisor
5	To organize and provide connection with dispatch center and points N1, N2,N 3,N 4	11 30	12 30		Trucks and communication means	Driver "-" "-" Head of communication department Communication dep engineer operator	Sargissian Movsissian Hovnanissian Manukian Dalakian Grigorian	Hajrapetian
6	To close valves on the points N1, N2, N3 on instruction of operators or heads of different services involved in the work	13 00	13 30			LOB deputy director Pipeline construstor "-" "-" Senior master	Tadevossian Manukian Danielian Vardanian	Hajrapetian
7	To provide valves lubrication on the pointsN1, N3			2	oil manometer wrench	Pipeline constructor "-" Senior master	Khachatrian Danielian Vardanian	Hajrapetian
8	Pipeline gas release to atmosphere	13 30	14 00				"-"	Hajrapetian
9	To provide first aid, fire fighting	8 30	22 30	1		Doctors, Fireman	tel 2-54,01(fireman) 03 (first aid)	Hajrapetian

Acting LOB director Hajrapetian A.

APPENDIX XII

N	Type of performed works	Section	Position	Name, surname	Equipment, mechanizms	Quantity
1	2	3	4	5	6	7
	Valves opening,closing, pipeline gas release, gas filling, provition of communication between points	a) point N1 pipeline Kazakh-Yerevan 93 km	Yerevan LOB director Pipeline constructor Communicati on engineer	Tadevossian Danielian Grigorian Hovhanissian	Trucks,instruments,materials,communicati on means	1
		b)point N2Kazakh-Yerevan pipelene 109 km	LOB deputy director Head of Communicati on center Driver	Tadevossian Manukian Sargssian	Trucks,instruments,materials,communicati on means	1
		c)Point N3 Kazakh-Yerevan pipelene	Yrevan LOB deputy director Pipeline constructor Communicati on technician Driver	Tadevossian Danielian Grigorian Hovhanissian	Trucks,instruments,materials,communicati on means	1
		d) Point N4 Khazakh-Yerevan pipeline 141 km	Yerevan LOB deputy director Head of Communicati on technician Driver	Tadevossian Danielian Grigorian Hovhanissian	Trucks,instruments,materials,communicati on means	
2	Hot works are performed	pointN2Khazakh - Yerevan pipeline109 km	LOB deputy director Works supervisor Excavator operator Welder “-” Team leader Metal worker			

APPENDIX XII

			Mechanic operator “_“ “__“ Auto lift Driver “_“ “_“ Pipeline constructor Head of Communicati on Center			
3	Persons participated in the works performance	PointN2 109 km Khazakh-Yerevan pipeline	Yerevan LOB deputy director Engineer	Tadevossian Balasanian		

Yerevan GDP Director M Hajrapetian
Engineer A. Balasanian

(name, surname, signature, date)

" Hajtransgas " joint company
(enterprise, organization)

Agreed	Agreed
(Position) (Position)	
Acting Director	Head of Abovian LOB Production-maintenance department
Arsenian	
_____	_____
(signature)	(signature)
"_____"June_____1998	"_____"June_____1998

Order-permission

Hot works performance

1) Site of works performance — Abovian LOB enterprise
(subdivision, object, equipment)

2) Name of works installation — Khazakh-Yerevan Ø 1020 mm pipeline 109 km meter

3) 3 Works Supervisor — Yerevan LOB Director, Hajrapetian
(position, name, surname)

4 Responsible person for preliminary works performance — Yerevan LOB deputy director Tadevossian
(position, name, surname)

5 Responsible person for hot works secure performance___
Yrevan LOB deputy director Tadevossian
(position, name, surname)

APPENDIX XII

6)It is required Oxygen -acetylene cutter

6 1Equipment , mechanisms, instruments equipment for pipe alignment ,welding unit

a) Lift unit, truck, water tank
(name, equipment N, quantity)

6 2 Eqipment spade,pick, hammer,different spanners

6 3 Metering station equipment , analyzer Gas metering station

6 4 Materials oil, valves,insulation materials, carbide, oxygen
6 5 (sentence is missing)
6 6 Disconnect electrical protection eqipment

6 7 Communication means Radio equipment
6 8 Fire fighting equipment

6 9 Medical equipment first aid kits, first aid car with its personnel
7 Provision of measures to prepare the object for works performance, to introduce team members with type of works,foreseen for performance , with regulations required for works implementation, To create connection between pointsN1, N2, N3

8 To provide measures to improve security conditions -To close valves on pipeline Khazakh -Yerevan 93 km N7 and 141km N10 , Sevan-Vardenis 0km 16 It is N111, 121km and all valves on N 59, 60 To disconnect valves from gas vents on point GagarN2 (pipeline Khazakh -Yerevan 93 , 96, 141km),to disconnect the valves from gas vents on pipeline Khazakh- Yerevan
9 Works regime --- Works begin at 8 00-22 00

10 Appendix –Technology diagram for metering unit installation on pipeline Khazakh - Yerevan Ø 1020mm 109 km
11 Agreed with interconnected shops and objects -- acting LOB-s (which are located close to the site ,where works are planned to be performed) are not disconnected , gas supply is not terminated
(N shop name, director, name, surname)

Head of LOB Hajrapetian
(signature, month, date)
12 Measures, foreseen for points N6,7,8,9,10,11 provide works security and efficiency It

is allowed to begin works after these works performance begin----------end
" " July 1998 Head of the
shop , Yerevan LOB director Hajrapetian June 1998
(name, surname, signature, date)
13 Agreed
13 1 with
(name, surname,signature, date)

13 2 Head of security service Balasanian A. July 1998

13 3 Preliminary works are performed , site is ready for works performance
Head of Yerevan LOB Hajrapetian June 1998
(date, responsible person signature)
14 Instructions are introduced in 1998

Following persons are instructed

N	Name	Type of work, employee position, signature	Employee is familiar with the conditions of works	Signature of person responsible for instructing
1	2	3		4
1	Khachatrian Micael	Pipeline constructor		
	Ananian Hrachik	Pioeline constructor		
	Danielian Khachik	Communication center		
	Manukian Mher	engineer		
	Dalakian Hakob	Works supervisor		
	Grigorian Agasi	Lead of the team		
	Terian Arshak	Weding operator		
	Sarkissian Grigor	Weding operator		
	Grigorian Edik	Excavator operator		
	Atabekian Spartak	Excavator operator		
	Bagdasarian Mehrab	Bullozer opertor		
	Avanessian Zaribek	Metal worker		
	Sarkissian Andranik	Driver		
	Arakelian Levon	Driver		
	Sarojan Mnatsakan	Driver		
	Antonian Onik	Driver		
	Tadevossian Andranik	Driver		
	Movsissian Naribek	Foreman		
	Sarkissian Anania	Communication center		
	Sahakian Slavik	operator		
	Mnatsakanian Martun	Line master		

16 It is accepted by the department and corresponds to mechanizms, equipment, instruments materials metering requirements

LOB Deputy director _Tadevossian_____(date, signature of person, responsible for hot works secure performance

17 Atmosphere condition control on the site, before works and after works performance

Control date, hour	Conrol site	Atmosph er composit ion	Allowed consentr ation	Control results	Name of person responsible for control	Signature

18 Hot works performance begin ----------hour--------min''--------''--------July------ 1998

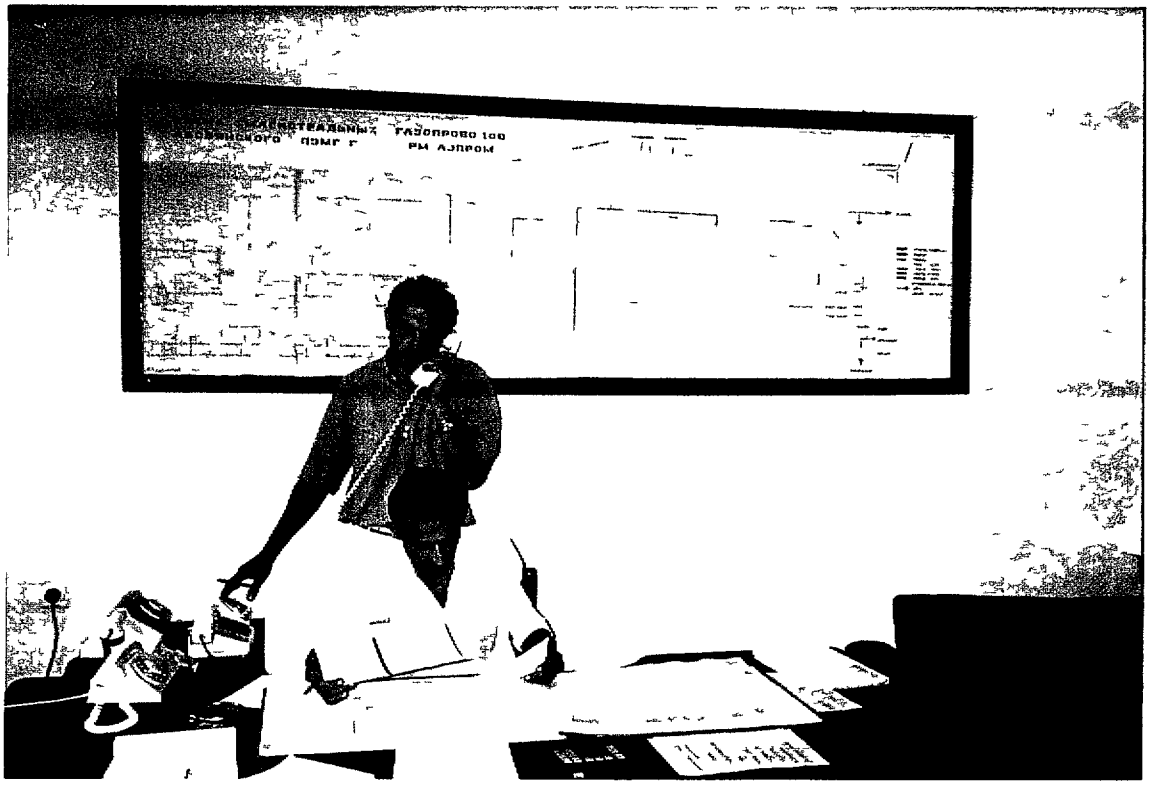
Works supervisor Head of Abovian LOB Khachatrian M
(name, date, surname)

19 Works are performed ,order-permission is fulfilled

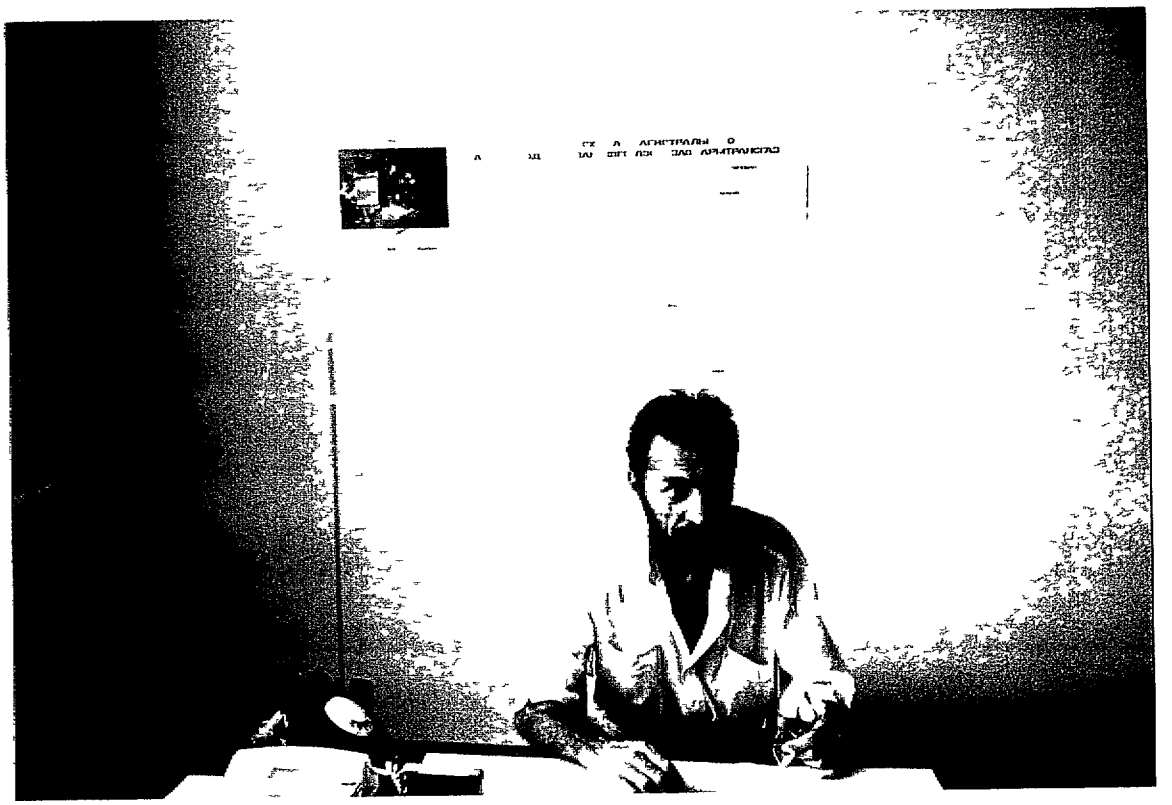
#1 SAHAK CHILONGARIAN, BURNS AND ROE INTERPRETOR AT "PIPELINE INTEGRITY AND EMERGENCY ACTION" MEETING

#2 PARTICIPANTS AT "PIPELINE INTEGRITY AND EMERGENCY ACTION" MEETING

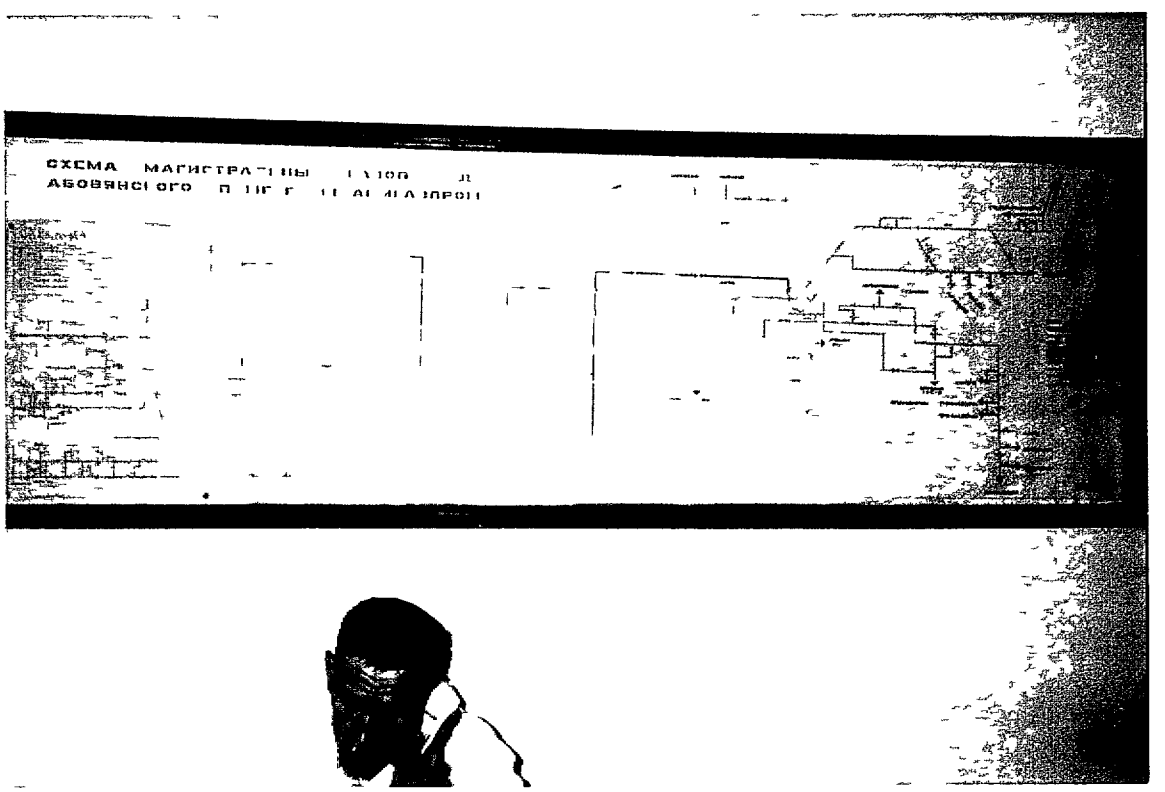
#3 SAME AS #2



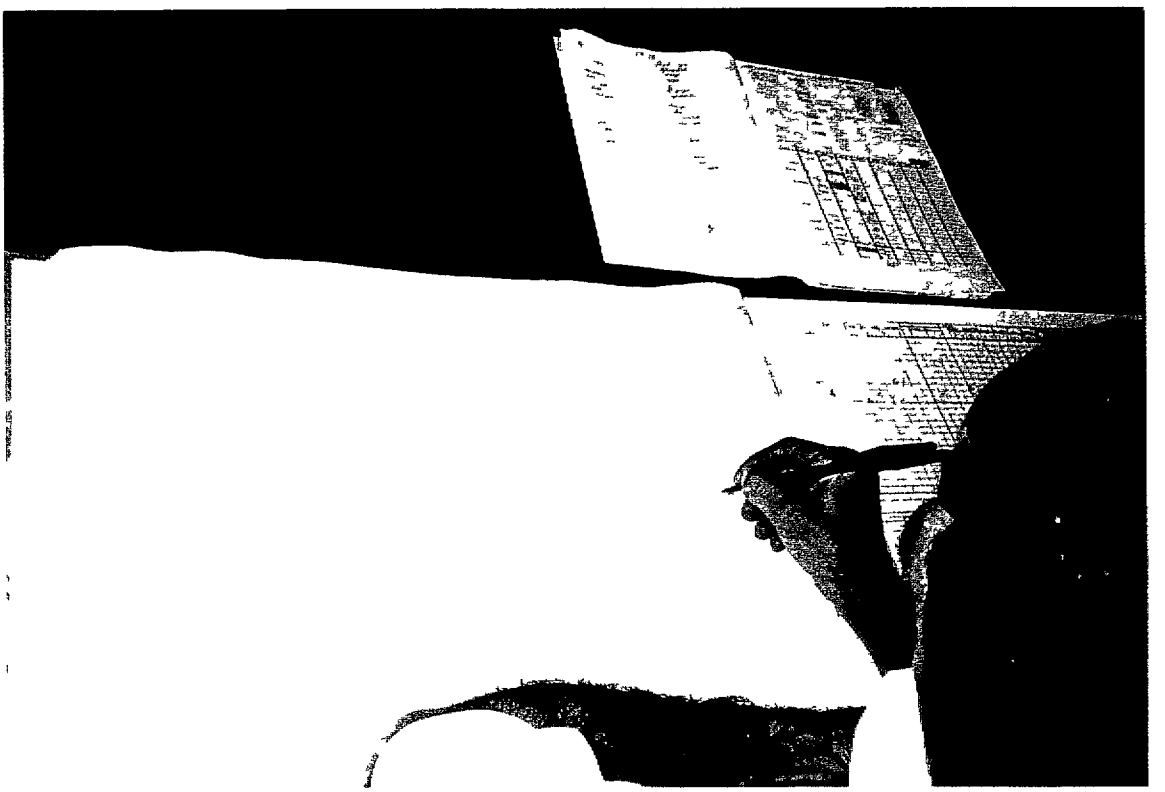
#4 CHIEF DISPATCHER BAIRAMIAN ARTION AND DISPATCHER AT ARNTRANSGAS OFFICE



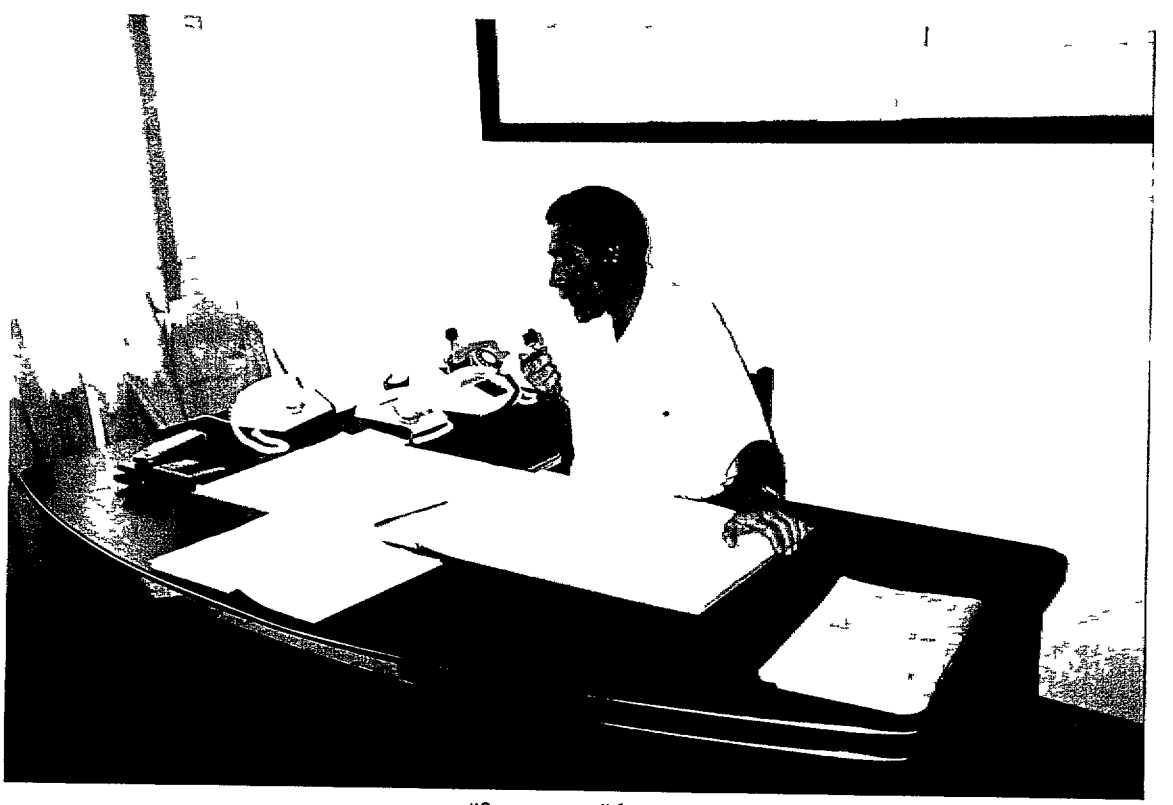
#5 YEREVAN LINEAR OPERATION BRANCH DISPATCHER



#6 ARMTRANSGAS HEADQUARTERS DISPATCHER

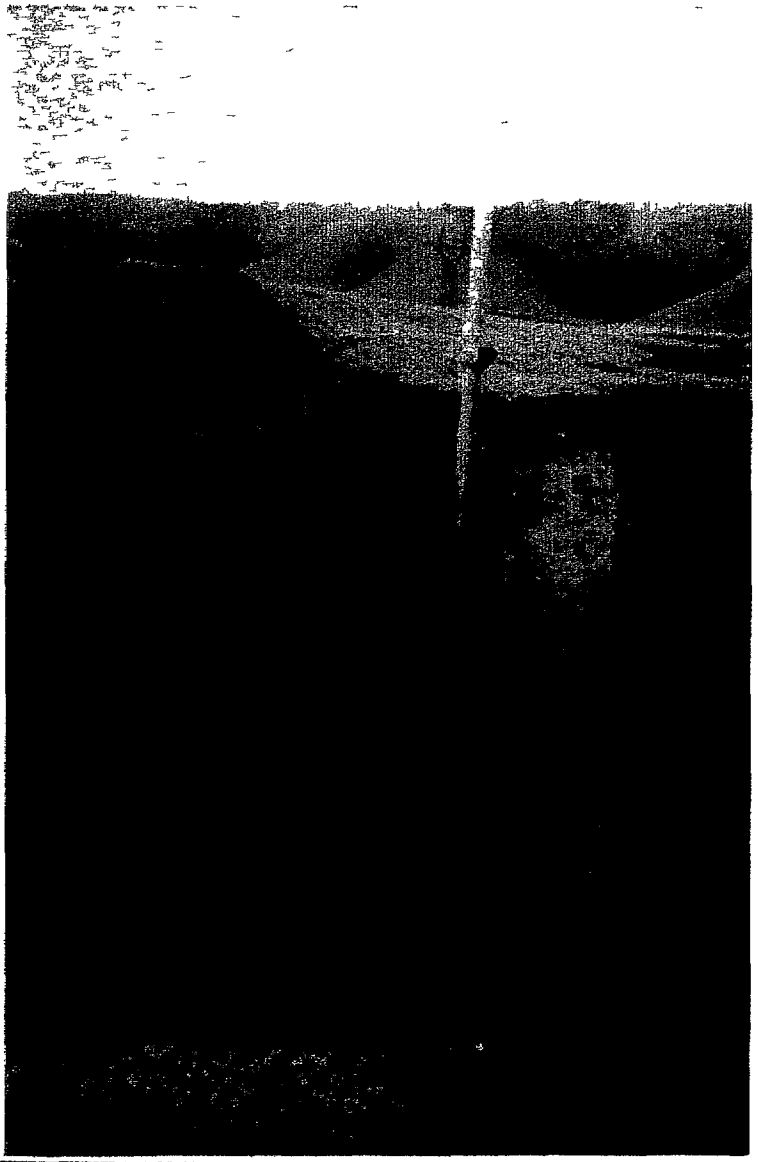


#7 ARMTRANSGAS HEADQUARTERS DISPATCHER'S LOG SHEET



#8 SAME AS #6

PHOTOGRAPH LEGEND



#9 ILLEGAL GAS CONNECTION NEAR KAZHAE YEREVAN
1020 MM (40" PIPE)

#10 530 MM (21") PIPE NEAR MADINSHOE

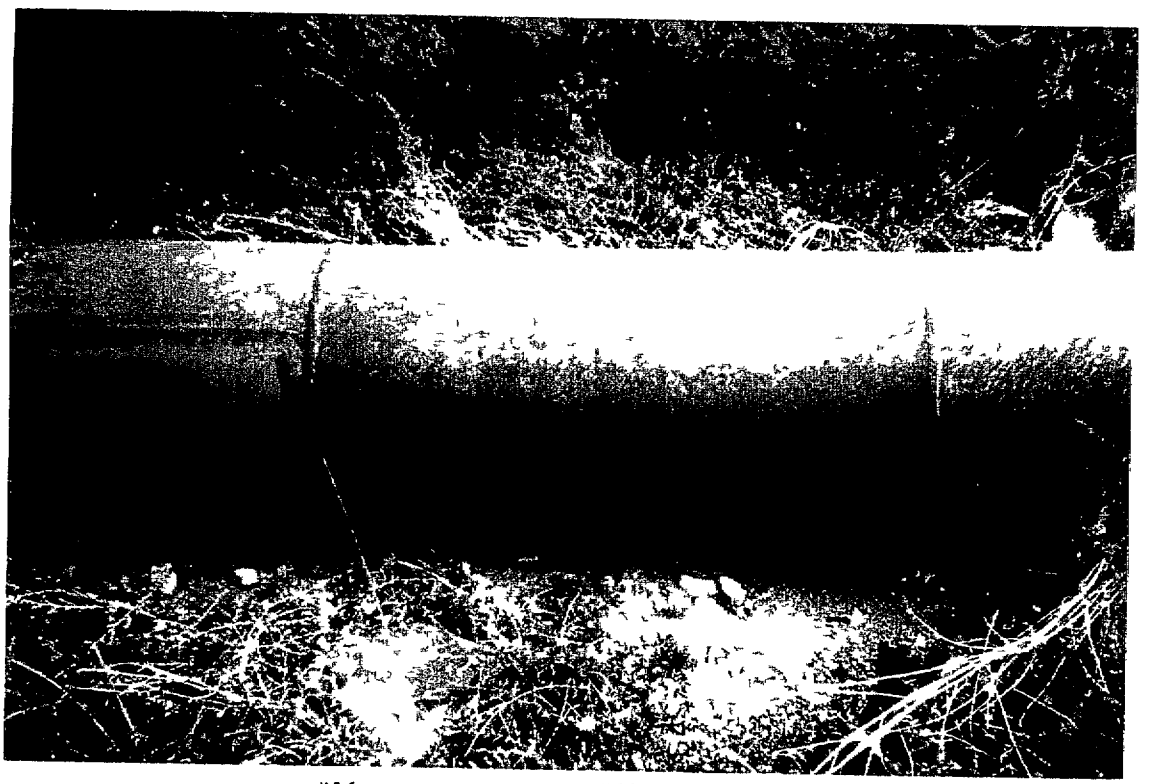
#11 530 MM (21") PIPE CORROSION NEAR TORFAVIN

#12 EXPOSED CORRODED 530 MM (21") PIPE NEAR VARDENIK

#13 CORRODED 720 MM (28") PIPE NEAR ILICHEVSE

#14 GAS LEAKING FROM WELD 720MM (28") PIPE NEAR ILICHEVSE

***#15** FLANGE CORROSION LEAK 1020 MM (40") PIPE*
NEAR BERD-SEVAN



***#16** REPAIRED DAMAGED 500 MM (20") PIPE*
NEAR SPITAK-GUMRI

#17 CORRODED 720 MM (28") PIPE
NEAR RICHEVSK - YERIVAN

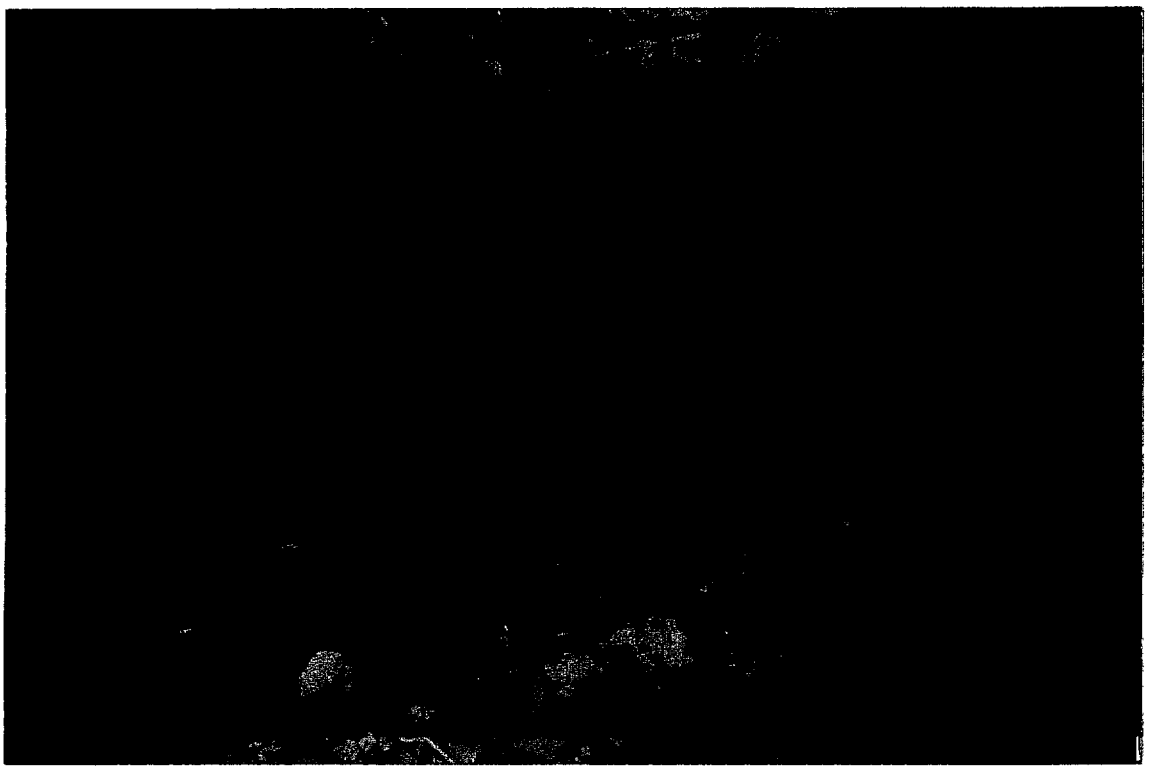
#18 LANDFALL 500 MM (28") PIPE NEAR
KAZAKH—SEVAN NEAR ARMANT

#19 CORROSION LEAK IN WATER (NOTE BUBBLES)
377 MM (15") PIPE

#20 CORROSION 530 MM (21") PIPE
NEAR SEVAN - JEZMUK

#21 VALVE BODY GAS LEAK 1020 MM (40") PIPE
NEAR BERN SEVAN

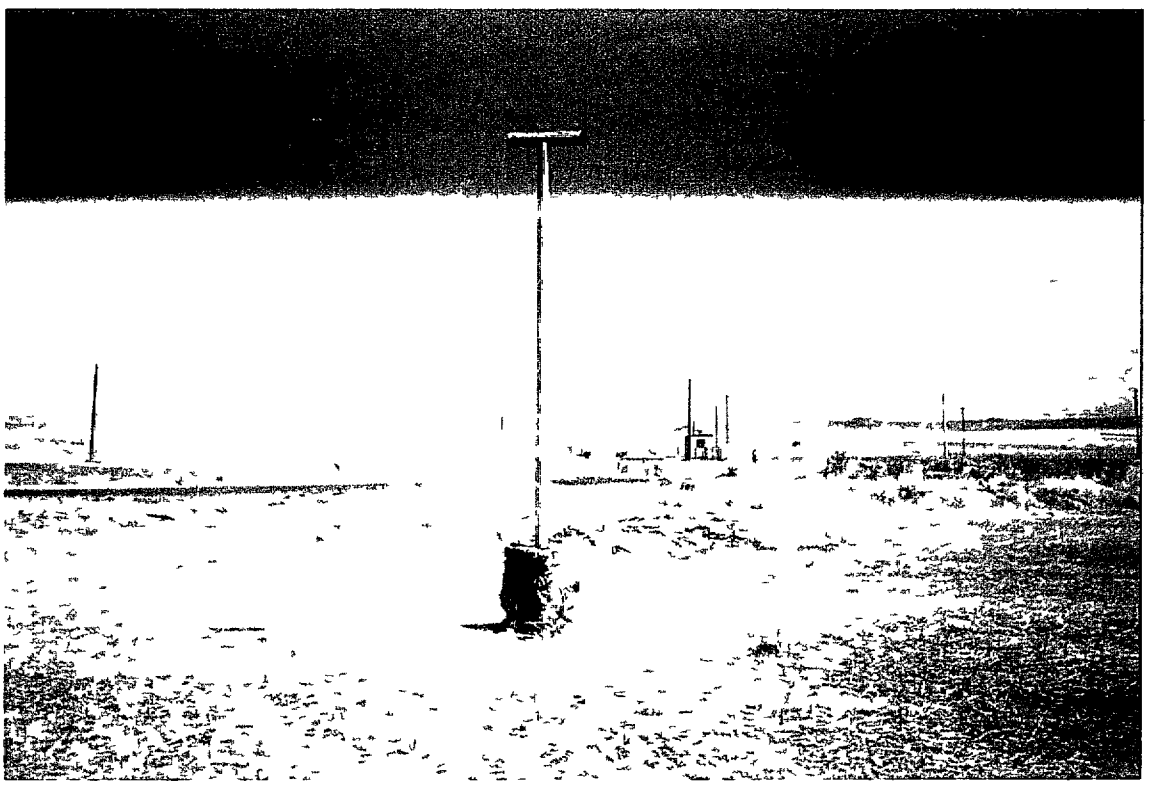
#22 CORROSION 720 MM (28") PIPE
NEAR RED BRIDGE – ALAVERDI



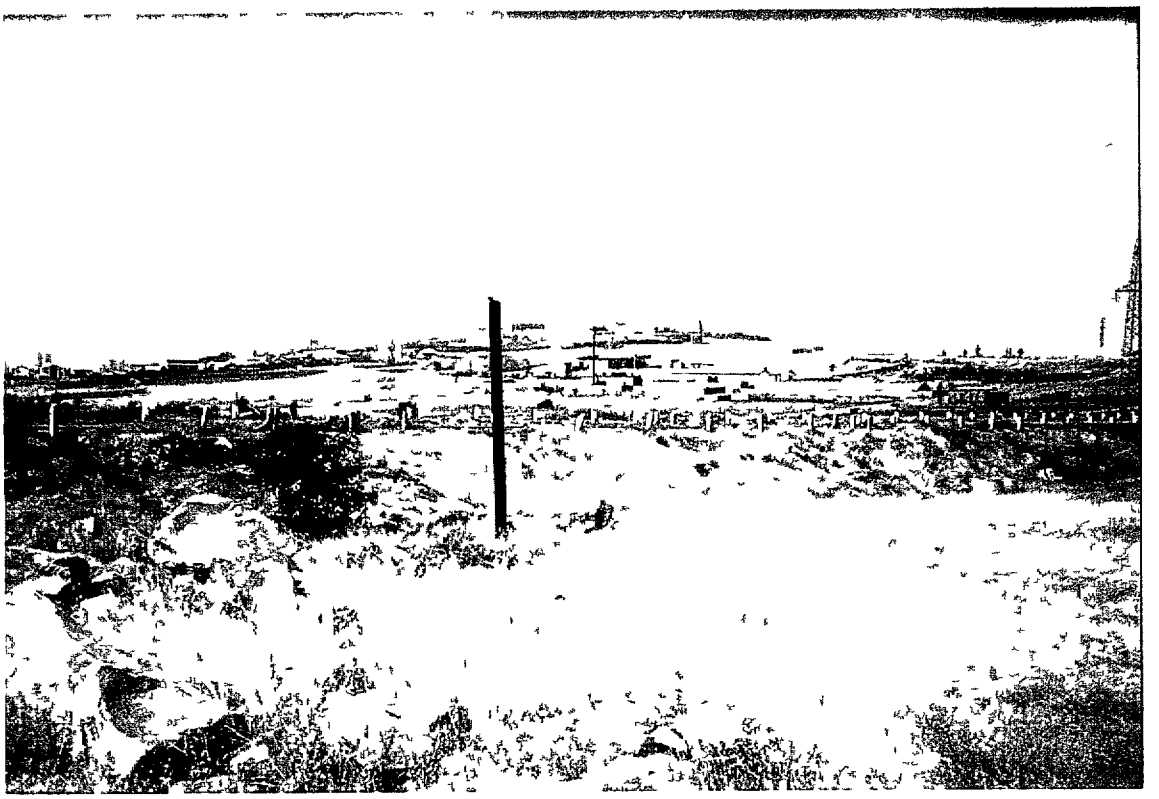
#23 CORROSION 720 NM (28") PIPE
NEAR RED BRIDGE - ALAVERDI

#24 CORROSION 500 MM (20") PIPE
NEAR SPITAH - GUMRI

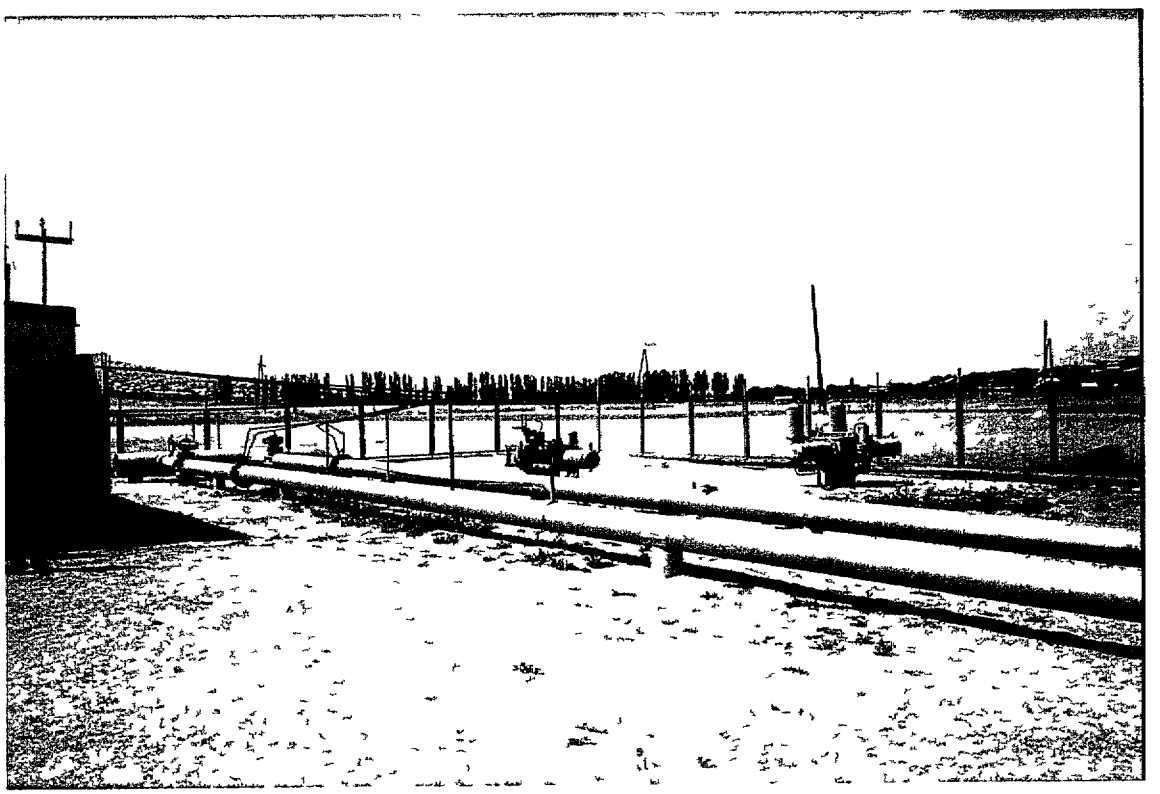
***#25** JILAVIAN YURI, DEPUTY DIRECTOR WITH INTERPRETOR*



***#26** CASING VENT AT ROAD CROSSING*

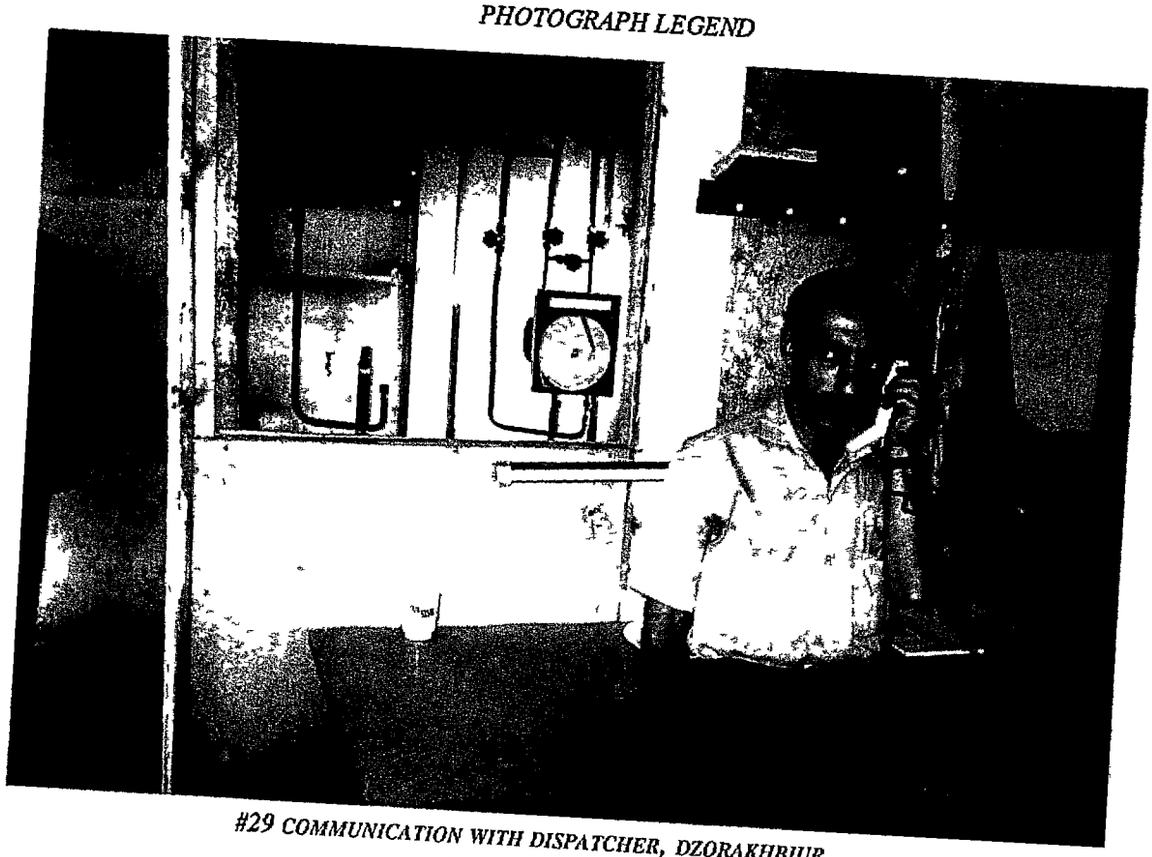


#27 SAME AS #26



#28 DZORAKHBIUR TRANSMISSION METER STATION
YEREVAN LOB

PHOTOGRAPH LEGEND

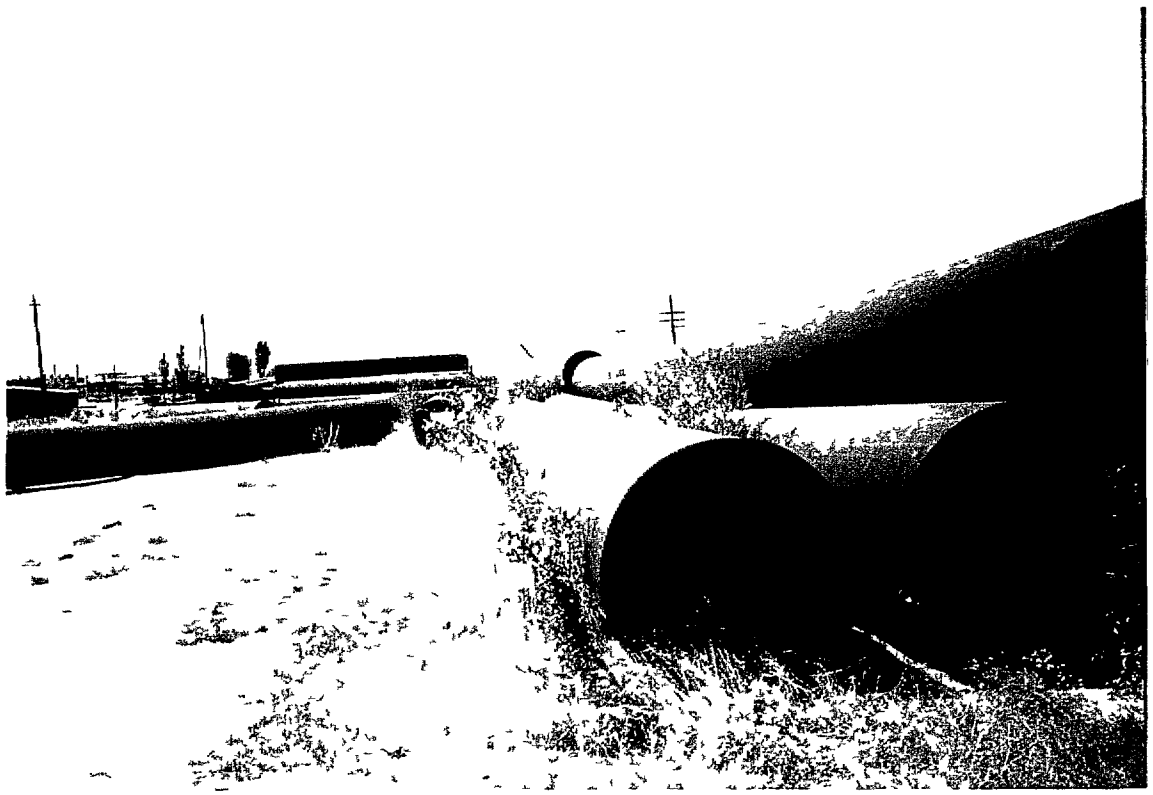


#29 COMMUNICATION WITH DISPATCHER, DZORAKHBIUR METER STATION

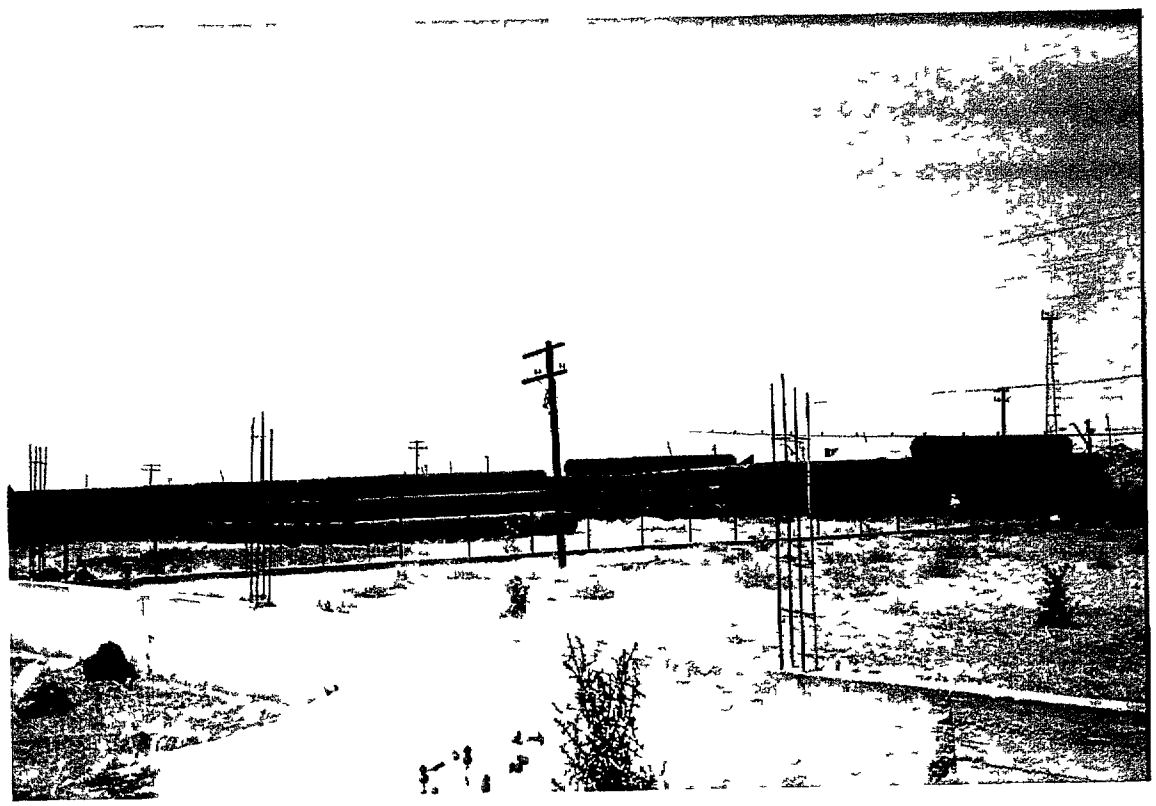
#30 ORIFICE FITTING, DZORAKHBIUR METER STATION

#31 DISTRIBUTION PIPE ABOVE GROUND BECAUSE OF ROCK

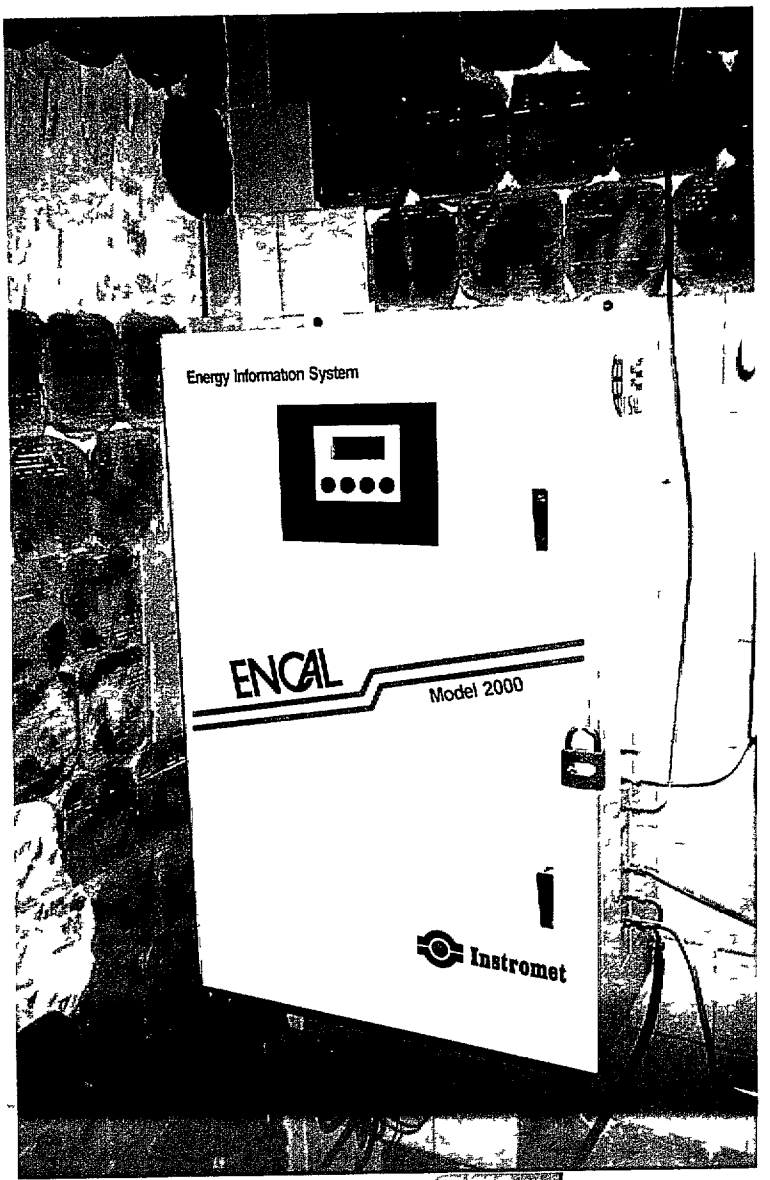
#32 CONSTRUCTION PIPE STORED AT YEREVAN LOB



#33 SAME AS #32



#34 SAME AS #32



#35 ENCAL CHROMATOGRAPH FURNISHED BY U S A I D – INSTALLED AT YEREVAN NO 1 WILL BE MOVED TO BEKTONIT DISTRIBUTION M&R STATION CLOSE TO THE GEORGIA BORDER

#36 CELEBRATION OF ARMENIAN GAS ENGINEFR'S DAY AT ARMTRANSGAS HEADQUARTERS

#37 SAME AS #36

#38 SAME AS #36

#39 SAME AS #36