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March 8, 1990

Mr. James B. Sullivan
Director
Office of Energy
Bureau for Science and Technology
Agency for International Development
Washington, D.C. 20523

Dear Jim:

Your weekly report dated December 31, 1989, reached me today. Perhaps it has been in the Mission awhile but to avoid such possible delays, I request you add my name to your mailing list here in USAID/Kingston. While you are doing this, you may also like to change Charles Mathews to Charles Scheibal, who has replaced Mathews as the Chief Engineer here in Kingston, as he retires from USAID on March 31, 1990. Done

My contract here now runs through July 1990, but I am beginning to look around to see what might be available about that time. As you may remember, I was pulled into the Mission here as fast as it could be arranged after Hurricane Gilbert hit the island on September 12, 1988, to assist with getting the power system back in order. We went from 0 to 99% in 10 weeks using aid from U.K., Canada, nearby islands and most important, by using contracts with five U.S. utilities and one U.S. electrical contractor to provide crews and equipment. The emergency restoration went so well that the Mission and the Agency acceded to a Jamaican request to continue assistance to the power sector under a follow-on Hurricane Reconstruction Project. This HRP project was initiated in February 1989 and moved along well until Hurricane Hugo passed through the Caribbean (and Charleston, S.C.) last September. At that time AID/W OFDA prevailed upon USAID/Jamaica to suspend work here and move our linemen and me as Project Manager to the Leeward Islands to restore the power distribution systems of St. Kitts, Nevis and Montserrat. OFDA assistance to those islands continued through January 9, when we returned to Jamaica to resume the rehabilitation and upgrading/energy conservation work under the HRP project.

MAR 22 1990

For your possible reference, I will include a copy of a debriefing report submitted by the Contractor's Superintendent, Mr. Richard Harrell and myself to the Regional Office in Barbados (RDO/C) on February 8, 1990. The report was well received by the attending group as outlined in Mr. Dean Moody's report on the meeting, a copy of which is included.

So, with this update on my activities and knowing of some of my past AID assignments, I would appreciate you letting me know of possible areas or positions I might consider for future work.

Sincerely,

Jay B. Carter

Jay B. Carter

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT
REGIONAL DEVELOPMENT OFFICE/CARIBBEAN

P. O. BOX 302
BRIDGETOWN
BARBADOS

February 26, 1990

Mr. Jay Carter
C/O USAID/Jamaica
6B Oxford Road
Kingston 5
JAMAICA, W.I.

SUBJECT: Hurricane Hugo Rehabilitation
Electric Power Restoration

Dear Mr. Carter:

This letter conveys the sincere appreciation of RDO/C for your efforts in securing electrical power restoration in the aftermath of Hurricane Hugo.

Your performance under contract with RDO/C was excellent. You displayed superior professional skills and technical knowledge. Equally commendable was your true concern for the welfare of people.

Thank you for a job well done.

Sincerely yours,

Aaron S. Williams
Director

UNITED STATES GOVERNMENT

memorandum

DATE: February 16, 1990

REPLY TO ATTN OF: Dean D. Moody/Infrastructure

SUBJECT: Hurricane Hugo, Electric Power Restoration, Lloyd Electric Operations

TO: To the File and Distribution

This memo serves as a report of the debriefing conference held 8 February 1990 at RDO/C offices, Bridgetown. Attendance:

USAID:
- Aaron Williams, Director, RDO/C
- James Baird, C/Infrastructure
- Christine Keller, Program Office
- John Wooten, Project Development Office
- Tyrone Watkins, Controller Office
- Barry Heyman, OFDA, AID/W
- Dean D. Moody, Infrastructure
- Winston McFee, LAC AID/W
- Jay Carter (PSC), USAID/Jamaica

Nevis Electricity Division:
- John M. De-Vries de Renzi

St. Kitts, Disaster Coordinator
- Ray Johns

Montserrat Electric Services Ltd.
- Hilton Housan—Howsen, Managing Director

Lloyd Electric:
- Bobbie Lloyd, Owner
- N. J. Thornton, Office Manager
- Richard Harrell, General Superintendent

Canadian Development Assistance Program:
- Maurice Lepage, Manager, Professional Services

British Development Division in the Caribbean:
- Doug Whitecross, OIC St. Kitts/Nevis
- Mr. Jerry Malley, OIC Montserrat

U.S. Department of Energy:
- James M. Brown, Special Assistant to the Dep. Asst. Sec. for Energy Emergencies

Caribbean Electric Utility Services Co.:
- Christopher Farrell, Executive Manager
- Brac Biggers, Advisor from NRECA

The meeting commenced at 9:20 when Chairman Moody introduced Aaron Williams. Williams welcomed the group and extended particular thanks to OFDA and its representative Barry Heyman for OFDA assistance to the region in the period following Hurricane Hugo. Williams also singled out Lloyd Electric for its effective implementation of assistance to the electrical rehabilitation effort.

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(REV. 1-80)
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5010-114
* U.S.G.P.O.: 1986-491-24[illegible]

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The meeting continued with Engineer Carter presenting copies of a report prepared by Richard Harrell and Jay Carter for the Project Debriefing Conference. The report can serve as an interim project completion report for OFDA. Attenders at the conference will present corrections and additions to Dean Moody. Moody will edit the report as appropriate for OFDA.

The meeting continued as a forum for discussion between attenders regarding the electrical rehabilitation effort, the problems encountered, actions taken to solve problems, planning for future operations, and conditions contributing to damage from hurricane force winds.

Discussions are reported by topic as follows:

MOBILIZATION

Advance positioning of the OFDA response team in Antigua provided rapid assessment of damage and facilitated response. Coordination of major assistance efforts between US, UK and Canada was accomplished by lead representatives in Barbados. Relevant background experiences as well as ability to respond were determinants in assignment of assistance efforts.

The availability of Lloyd Electric crews working on hurricane rehabilitation efforts in Jamaica permitted a rapid response to provide electrical restoration assistance in St. Kitts and Nevis. As it later developed, the crews and equipment provided a welcome assist to the UK and Trinidad forces working in Montserrat.

USAF air transport of equipment to Nevis was a singular and highly effective means to expedite assistance efforts. Which leads to the next topic,

TRANSPORTATION

The period following the Hurricane Hugo was marked by transportation difficulties. Without the USAF assistance, electrical restoration would have been sorely delayed. It was pointed out in the discussions that port and airfield facilities were damaged and the needs of the region were multiplied by hurricane damage. People were both coming and going, individuals as well as assistance groups were dispatching supplies and goods to the region, all of which severely strained transport facilities. This condition continued months past the arrival of Hugo.

On a related matter, Lloyd Electric reported difficulties in obtaining quarters and meals for its crews on St. Croix due to an influx of sightseers. (Lloyd had a contract for construction services on St. Croix separate from the USAID contract)

Ocean shipping was utilized in several instances, and was not timely. It was suggested that OFDA investigate the use of US Navy vessels for future emergency needs. LST vessels would have been highly advantageous for Hugo emergency supplies, particularly

in Montserrat where docking facilities were damaged.

MATERIALS

Materials were ordered immediately following the hurricane by the Electric Department of St. Kitts. When they finally arrived, difficulties with payments delayed handover of the material. AID project funding was redirected to fund primarily personnel, equipment rental and tools to the exclusion of materials funding. Materials were excluded as they were on order and the Memorandum of Understanding with the government of St. Kitts and Nevis noted provision of materials.

COOPERATION

The St. Kitts and Nevis Electrical Department and the Montserrat Electric Services Ltd. were highly effective in providing technical direction and coordination between local electrical crews and assistance forces. On Montserrat the cooperation between UK and Lloyd crews was very effective in assigning duties suited to crew skills and equipment.

It was noted at the conference that the populace as well as officials were quite supportive.

DAMAGE FACTORS

Storm damage to outside plant was compounded by construction deficiencies. A main deficiency was insufficient depth of pole setting. Quite prevalent was excessive communication conductor loading. Communication construction often neglected proper guying of communication conductor loads. Tree trimming would have reduced damage from tree and limb falls. Storm guys were not used on long spans. Routine pole line inspections would have identified butt rot of poles at ground line.

MISCELLANEOUS

Lloyd Electric remarked that the availability of excellent system maps on St Croix were an excellent aid to reconstruction. The value of two pole trailers are less that the cost of shipping them back to the lessor in Georgia. It was agreed that Lloyd Electric should purchase the trailers and leave one in Monserrat and one in Nevis. This should be confirmed in a letter to Barry Heyman.

xc to distribution:
AWilliams
JBai[illegible]
JWooten
BHeyman
JCarter
BLloyd

HURRICANE HUGO

Electric Power Restoration

St. Kitts -- September 27 - October 16, 1989

Nevis -- October 3 - November 16, 1989

Montserrat -- November 17, 1989 - January 9, 1990

by

LLOYD ELECTRIC CO.
Wichita Falls, Texas

Under Contract to OFDA/W

Contract No. SPO-0000-C-00-0002-01

Administered By

USAID/Bridgetown

Regional Development Office

for the Caribbean

Report Prepared by

Richard Harrell
Superintendent
Lloyd Electric Co.

&

Jay B. Carter
Project Manager
USAID/RDO/C

for the Project Debriefing Conference

of USAID/RDO/Caribbean

on

February 8, 1990

INDEX

1. INTRODUCTION

Hurricane Hugo developed in mid September of 1989. By the time Hurricane Hugo had arrived in Lesser Antilles of the Caribbean, the storm had intensified into a Force 4 hurricane. Hugo's path passed through the Leeward Islands on September 17th and 18th, causing extensive destruction to structures, power and communication systems, and agriculture on several of the islands. The most serious damage occured on the islands of Guadeloupe, Antigua, Montserrat, Nevis, St. Kitts, Saba, Martinique and St. Croix. An Office of Foreign Disaster Assistance (OFDA) team, headed by Paul Bell, was in position on Antigua, anticipating Hugo's arrival.

During the initial response, the OFDA team coordinated emergency services, including medical services. Paul Bell and his team distributed food, medical supplies and plastic sheeting for temporary roof repairs to the islands of St. Kitts, Nevis, Montserrat and Antigua. The operation was based out of the U.S. Embassy in Antigua.

Jim Baird, Chief Engineer of RDO/C, aided OFDA by providing an evaluation of damage to the infrastructure of the various islands. Mr. Baird recognized the extensive damage to the electrical systems of the affected islands and determined a priority need for power restoration. OFDA called on USAID/Jamaica to lend the help of Hurricane Gilbert restoration crews which were still employed in Jamaica under USAID/Jamaica funding. Jamaica Mission Director, William Joslin, agreed to a temporary suspension of the Jamaica Hurricane Reconstruction Project involving the Lloyd Electric Company, Inc. and Jamaica Public Service Company (JPS). JPS agreed to suspend the Lloyd Electric work in Jamaica so that emergency assistance could be quickly sent to the hurricane damaged islands. In fact, JPS also sent a 9 man team of their best linemen to Antigua on September 30, where they worked with other restoration crews for a month.

On September 20, 1989, OFDA/W funded travel for Richard Harrell and Jay Carter from Jamaica to Antigua for the purpose of

making a power system damage evaluation and to prepare preliminary planning for providing power restoration assistance. Jay Carter, a contract Engineer with USAID/Jamaica, had, as Project Manager, coordinated the activities of the USAID power restoration teams with JPS during the 1988/89 Hurricane Gilbert power system restoration. To facilitate suspension of the Jamaica work, the movement of Lloyd Electric crews to the Leeward Islands, the expediting of agreements with local utility and government offices, and to generally support and monitor the Lloyd Electric operations, RDO/C contracted Jay Carter to act as Project Manager for the duration of the Lloyd Electric contract with OFDA. Richard Harrell, a Journeyman Lineman employed by Lloyd Electric as Superintendent, supervised the Lloyd Electric operation during power system rehabilitation in the aftermath of Gilbert.

On September 22nd, Dean Moody, an Engineer of the USAID/Bridgetown RDO/C office, arrived on Antigua to further assist with damage evaluation and with the planning stages of Hugo restoration. Mr. Moody as the RDO/C Project Officer for this activity has monitored the field activities, provided liaison between RDO/C and the OFDA/W offices, the island governments and utilities and provided guidance and support to Project Manager, Jay Carter.

Evaluations of system damage began with a survey of Antigua on September 21st, followed by visits to St. Kitts and Nevis on September 22 - 23. An evaluation of damage on Montserrat took place on October 10, 1989.

2. INITIAL EVALUATIONS

The damage evaluation of Antigua was made on September 21, 1989. The overall damage to Antigua was very moderate. There were areas of substantial destruction on the island, especially on the south and west sides, but overall, Antigua had only incidental damage. Damage to the electrical system was a 20 - 30% overall loss. The destroyed power lines were largely the result of

decayed poles and improper use of poles under joint-use agreements with telephone and cable television companies. The wind loading resulting from hanging numerous large size cables on poles which were not designed for such use, caused long sections of the power lines to be blown over on the ground and into the roads.

On the evening of the 21st, Lloyd Electric was advised that the donor nations of the USA, Great Britain, and Canada had met in Barbados and an agreement was reached on areas of assistance. This agreement assigned to the United States responsibility for assisting with the electrical restoration on the islands of St. Kitts and Nevis. Great Britain accepted the same responsibility for Antigua and the British colony of Montserrat.

Evaluation of St. Kitts began on September 22, 1989. Lacking sufficient time for an evaluation tour, a meeting was held with the Department of Electricity Manager, Mr. P. H. L. Huggins; Disaster Coordinator, Mr. Ray Johns; the Prime Minister, and other Ministry officials. The housing damage was moderate. Only 5% were totally destroyed and 30 - 50% had roof damage.

Infrastructure damage was mostly to the electrical system. The damage to the system was moderate; probably a 20% overall loss. Most system damage was on the west and north coast. Also damaged were the phone and cable television systems which were attached to the power poles. Water service was non-functional to most of rural areas because of the electric power outage. The roads were blocked but suffered very little permanent damage.

The economic damage to St. Kitts appeared minimal. Damage to structures was mostly to houses; most businesses suffered very little damage. Tourism was suspended briefly, resulting more from adverse publicity than actual damage. Some hotels were out of power but that problem was quickly remedied.

The evaluation team visited Nevis the following day, September 23rd. Housing had suffered more destruction on Nevis than on St. Kitts. The damage was still in the moderate range with probably 15% destruction of houses and a 40 - 50% loss of roofs.

The infrastructure had taken a major loss with the electrical system being approximately 60% destroyed. The phone system was destroyed along with the electrical system in most areas, as was the cable television. Food storage was an immediate problem because of lack of refrigeration. The water system was not working because of the electric power outage. To alleviate this situation, the Canadian International Development Agency (CIDA) rushed emergency power generators to the pumping stations.

The damage to the Nevis economy was fairly serious. Three of the eight significant hotels were destroyed. Tourism was essentially lost for the 1989/90 holidays because of no electricity and adverse publicity. A large construction project, the Four Seasons Hotel, was discontinued for two weeks and work was carried on at a reduced rate for the following month.

The evaluation of Montserrat, On October 10, 1989, concluded that the island was severely damaged in all sectors. The housing damage probably exceeded 30% totally destroyed and an additional 40% extensively damaged. At least 90% of the houses had significant roof damage and more than half of the houses had roofs that were totally lost.

Infrastructure damage, mostly in the area of the electric power system, was also severe. Ninety percent (90%) of the power lines were destroyed. The telephone and cable television systems fell with the power line structures. Refrigeration for food and medical supplies was non-existent. The water system was non-functional because of the power system outage. Generators were used to provide 70% of the water supply until mid-December.

Along with the housing and infrastructure destruction came the loss of a tourism-based economy. There would be very little tourism for the remainder of 1989, and only an incidental tourist trade in the early season of 1990. The vacation villas on which the tourist industry depends had been damaged and none were to have electricity until December. Montserrat previously had some agriculture production from truck farms and banana fields and all were a total loss. The harbor pier also was destroyed during the storm and that caused significant problems to the shipping industry and to restoration activities which needed lumber, roofing, furniture, glass and appliances in large quantities.

The need for immediate assistance to aid in electric power system restoration was apparent on all three of these islands. Electricity was necessary to begin restoring the economy. Tourism, light manufacturing, and retail operations all require electrical power. The humanitarian need was readily apparent because electricity is necessary for the water system, medical facilities, food storage and residential electrification.

Timely restoration would require skilled linemen who were trained and experienced in the use of hydraulic equipment and productive construction techniques and power line materials.

The British supported contractor British Electric Industries (BEI) was on Montserrat but without line equipment. The Montserrat Electricity Department requested immediate assistance from Lloyd Electric crews and tenative plans for providing such assistance were prepared. However, the British Government felt that further assistance would not be needed or at least this was the impression received in OFDA/W.

3. PRELIMINARY ARRANGEMENTS FOR POWER RESTORATION ASSISTANCE

Because of the recognition of a need for assistance on St. Kitts and Nevis, OFDA/W, by telephone, verbally expressed their intent of negotiating a contract with the Lloyd Electric Company, Inc. on September 25, 1989. The understanding expressed was that

Lloyd Electric personnel currently employed in Jamaica would be mobilized for a move to St. Kitts as soon as possible. Adequate equipment would be mobilized by Lloyd Electric in the U.S. and transported to St. Kitts by Air Force C5A Galaxies. The intent was to have the equipment arrive simultaneously with the Lloyd Electric personnel from Jamaica.

Carole Siegel, the OFDA/W Procurement Officer, immediately began negotiations with Robert Lloyd to formalize the above arrangements with a contract. The Contractor, Lloyd Electric, acted quickly and within 48 hours located the best equipment available on such short notice. Lloyd Electric actually mobilized the equipment prior to receiving a formal Letter of Intent from OFDA/W in order to meet the U. S. Air Force C5A flight schedules to St. Kitts.

Mobilization plans to respond to the needs of St. Kitts and Nevis were undertaken in Jamaica and in Wichita Falls, Texas. Plans called for thirty-two (32) personnel with complementary equipment to be divided into six crews. The organization was as follows:

4 crews with the primary function of pole replacement were manned and equipped as follows:

4 men, one being a foreman, on each crew
1 digger derrick for each crew
1 support vehicle for each crew

2 crews with the primary function of conductor replacement were manned and equipped as follows:

5 men, one being a foreman, on each crew
2 aerial lifts (bucket trucks) for each crew
1 support vehicle for each crew

Additionally, there would be five (5) support personnel with the operation:

1) Superintendent, using one light vehicle
2) Mechanic, using one light truck
3) Material expeditor, using one light truck
4) Administrative Aide, using one light truck
5) Secretary - Timekeeper.

The logistical requirements for the arrival of the operation were outlined to Paul Bell, the OFDA team leader. Alejandro James, assistant to Mr. Bell, made most of these arrangements. Mr. James' handling of this matter was excellent. Mr. James visited St. Kitts and made lodging arrangements which included providing three meals per day, arranged so that a twelve hour per day work schedule could begin at 6:00 a.m.; hotel space or housing to consist of comfortable airconditioned accommodations, single rooms when/where available; and laundry service for large quantities of very dirty clothes. Mr. James also arranged with Dade County, Florida, an OFDA/W contractor, for the installation of a UHF radio system and for first aid training.

Movement of personnel from Jamaica was carried out in four groups due to non-availability of sufficient number of commercial airline seats on any given day. The first group left Jamaica on September 27th and the last group left on October 2nd and arrived on St. Kitts on October 3, 1989.

Mobilization of equipment was accomplished by two USAF C5A flights. The first flight was on September 29th and the second flight was on September 30, 1989. The C5A's delivered the following equipment from Texas and Georgia to St. Kitts.

5 digger derricks
4 aerial lifts (bucket trucks)
2 pole trailers
4 crew cab pickups
1 Chevrolet Luv pickup
2 - 40 foot vans for tolls and material storage

Approximately $80,000 of tools and material arrived with the equipment.

Ten men (two crews and equipment) were moved by barge and ferry to Nevis on October 3, 1989.

Plans from the beginning were to move as quickly as possible to restore power on St. Kitts and move all forces on to Nevis where more time was needed to acquire construction materials.

Material for power restoration was available on St. Kitts and Lloyd Electric supervision was on St. Kitts, all of which resulted in cleaning up the St. Kitts problems in a short period of time.

4. POWER RESTORATION ACTIVITIES ON ST. KITTS

Before Hurricane Hugo, St. Kitts had a reasonably well maintained and adequately designed power system. The 11 KV primary backbone was a ring feeder that circled the entire island. It was routed through cane fields so there were few bushing, access, or 'danger' tree problems. The significant weakness of the power system was the use of Wallaba poles. These poles are not properly treated with preservatives, resulting in early butt decay problems. Wallaba is also a brittle wood causing even the good poles to often break during hurricane force winds.

Hurricane Hugo inflicted an estimated 20% loss of the electric power distribution system on St. Kitts. Many of the poles simply fell in the soft soil of the cane fields. Many conductor ties broke and the wire only had to be retied. The system overall, received moderate or less than moderate damage.

There were several contributing factors to the damage of the St. Kitts system. Wallaba poles, decayed poles, inadequate setting depths, and inadequate guying all contributed to avoidable losses. Telephone and cable television, with their additional cross section and with inadequate guying, caused a great deal of the structure failure.

The restoration requirements varied greatly on this small island. The hurricane was apparently more intense on the west and north sides of St. Kitts. In those areas, pole loss amounted to about thirty percent (30%).

An additional 20% of the conductor was down, and 80% of the service cables were damaged. The east side of the island had

minimal damage with only 10% of the poles down and probably 30% of the service drops damaged.

Southern St. Kitts, including Basseterre, also suffered minimal damage in the range of 10% pole failure, 20% of the conductors down, and 30% of the service cables down.

When Lloyd Electric began restoration, the power system of the capital city of Basseterre was already 90% functional. On the eastern side of St. Kitts, an area of light damage, restoration was underway with local forces. In western St. Kitts, the 11 KV line was repaired to the isolating switch at Palmetto Point, near the village of Challengers.

On October 1, 1989, a Restoration Plan was formulated from a basic plan provided by the Department of Electricity Manager, Mr. P. H. L. Huggins and Mr. Royden Benjamin, Special Minister for Communications and Youth Activities. After discussion and some modification, an agreement to provide worker safety and timely restoration was reached. Under this agreement, Lloyd Electric was to be responsible for restoration of the primary 11 KV feeder on the west side of St. Kitts from Palmetto Point north toward a point to be determined by job progress. Lloyd Electric was to restore secondary circuits after the primary ring was completed. The Department of Electricity (D of E) would be responsible for restoration of primary and secondary circuits on the east side of the island, from Cayon to a point also to be determined by job progress. D of E would also restore the secondary circuits on the western side of St. Kitts as Lloyd Electric restored the primary lines.

Lloyd Electric restored all of the 11 KV primary lines between Palmetto Point, near Challengers, to Dieppe Bay Town, in northern St. Kitts. This was approximately eighteen (18) miles. Ninety-five (95) new poles were erected and 75 existing poles were either plumbed or reset. One hundred and forty (140) spans of conductor were replaced.

This restored electricity to several communities including:

Challengers	50 residences
Old Road Town	150 residences
Verchilds	50 residences
Sandy Point Town	1,000 residences
Newton Ground	150 residences
St. Paul's	200 residences
Dieppe Bay Town	200 residences

This restored electricity to approximately 1,800 residences. Commercial consumers restored included an electronics manufacturer, four hotels, Romney Manor (textile shop), four service stations, and numerous small shops.

After restoration of the 11 KV primary lines, Lloyd Electric restored the secondary circuits and service drops in the communities of Newton Ground, St. Paul's and Dieppe Bay Town.

The restoration of power to St. Kitts was expedited by several circumstances. Ray Johns, St. Kitts' Disaster Coordinator, was very helpful. In general, the line trucks had access to the line and the digging for pole holes was fast because the soil was not extremely rocky. The arrangements of the D of E proved most valuable. In the first instance, Mr. P. H. L. Huggins had a good basic plan worked out and then demonstrated the flexibility of his plan to suit the work methods of Lloyd Electric. The D of E furnished a liaison team of retired employees to aid Lloyd Electric in material acquisition, in obtaining directions, and in providing coordination between Lloyd Electric and D of E field personnel. Many of the poles that were needed were already moved by D of E from Stores and spotted on the right of way near the broken poles that were to be replaced prior to our arrival. A convenient fueling depot was arranged and fuel was furnished by D of E. A convenient staging area was also arranged. The point most appreciated was that the St. Kitts D of E observed the safety agreement between Lloyd Electric and the D of E without exception.

St. Kitts removed any obstacles that could hinder the production of Lloyd Electric during restoration. Lloyd Electric was provided a very positive work situation which benefited the people of St. Kitts.

Lloyd Electric started restoration work on St. Kitts on October 3, 1989 and finished restoration and departed for Nevis on October 16, 1989. Restoration work on St. Kitts took thirteen (13) calendar days, or eleven (11) work days. This represents 176 total man days for the restoration phase on St. Kitts. Power was 95 % restored to St. Kitts in less than thirty (30) days after Hurricane Hugo.

5. RESTORATION OF ELECTRICAL SERVICES FOR NEVIS

The electrical system serving Nevis appears to have been a very poorly maintained system for many years. The design of the system lacked strength due mainly to inadequate guying. The quality of workmanship used in the original construction of the lines was very poor. The right of way had not seen any maintenance for twenty (20) years. The lines were generally routed through palm groves and wooded areas with no consideration being given to danger trees. In many areas there were no vehicle access routes to the pole sites because of both terrain and brush. The conductor was old and brittle. In many cases, the attachment ties were incorrectly made and utilized inadequate material.

Their poorly maintained system sustained severe damage during Hurricane Hugo. Approximately 50% of the poles were down and an additional 20% of the conductor was on the ground. Eighty (80%) percent of service lines were no longer attached.

The extreme loss of power lines was caused by poor maintenance. A very high percentage of the poles were seriously decayed and had needed replacement for years. Wallaba poles which

are prone to decay and have little resilience, were used throughout the system. The design had minimal guying which accounted for many structure failures. Proper pole depth was rarely observed; poles commonly were set three (3) feet in the ground. Guy anchors were installed at three (3) feet depth and less. Even though the line structure was in this weak condition, telephone and cable television lines had been attached without structural upgrading. This additional cross section increased wind loading but was rarely supported by guying dedicated to the added load. The power line conductor was old and brittle. The power lines had numerous splices, many of which were due to previous line breakages. Lines were frequently tied to the insulators with wire unsuitable for conductor attachment. The attachment ties had never been maintained and many ties were probably broken before the arrival of Hurricane Hugo.

Required restoration was extensive. Charlestown, where only a few Wallaba poles were utilized, had only a 20% pole loss. Eighty (80%) percent of the services were broken away from their points of attachment. In the fringe areas of Charlestown, the incidence of structure failure increased proportionately with the use of Wallaba poles. In the rural areas, where structures were constructed almost exclusively of Wallaba poles, loss was in the range of sixty (60%) percent. Nearly 80% of the conductor was down and very near 100% of the service lines were torn down.

The Nevis Department of Electricity (D of E) had restored service to the downtown Charlestown area before the Lloyd Electric operation arrived on October 3, 1989. This was a small and easily restored area. The D of E had begun to restore service to the remainder of Charlestown.

Prior to the arrival of the balance of the Lloyd Electric personnel from St. Kitts on October 17th, there did not appear to be a general plan for power system restoration. The Lloyd Electric superintendent having found a workable restoration plan developed in St. Kitts, hoped the same would be true for the

D of E on Nevis. However, this was not the case and due to transportation difficulties between the islands of St. Kitts and Nevis, no real plan was put in place until Harrell's contingent arrived on October 17th. In any event, work assignments given to Lloyd Electric crews prior to the arrival of Harrell on Nevis seemed to be directed toward restoration of power to certain houses rather than to power system restoration.

The basic work plan formulated by Lloyd Electric on October 19th was to restore the primary system, then to repair the secondaries. To accomplish this objective, the operation was divided into two equal operations. The Nevis D of E and a local contractor were to begin restoration of the secondary distribution lines on the poles previously erected by Lloyd Electric for the primary lines.

The operation on the south side of the island was housed at Old Manor Hotel and staged from the Market Shop Police Department grounds. This operation began restoration southward from Charlestown with the objective of reaching Whitehall. Among the major objectives was restoration of power to water wells and pumping stations. After completing the primary line to Whitehall, restoration of secondaries was undertaken where need was indicated.

When the balance of the Lloyd Electric crews arrived at Nevis on October 17th, the 10 men working there since October 3rd had already restored all of the outlying areas of Charlestown. On October 18th, the overall plan for use by all the Lloyd Electric crews was implemented.

In restoring the 11 KV primary system, Lloyd Electric erected an estimated 400 poles and plumbed 200 other poles. Five Hundred and Fifty (550) spans of primary conductor were positioned back on the insulators. This restored an estimated 35 miles of primary lines. Replacement or repair was needed in every mile of the system. Estimates place 6,000 of the 10,000 people of Nevis

residing outside of Charlestown. Therefore, Lloyd Electric returned electrical service to over 6,000 people by restoring the 11 KV primary system.

Secondary restoration was provided to all tourist hotels except one, all the tourist villas, clothing and crafts manufacturers, restaurants and the construction site of the Four Seasons Hotel, which is the largest building project ever undertaken on Nevis.

The D of E helped Lloyd Electric with the restoration efforts in several areas. The restoration plan and the agreed upon safety procedures were followed. Nevis government provided secure staging area convenient to our work. Lloyd Electric was also provided with fueling depots convenient to our work. The local contract crew hired by the D of E was productive and cooperative. The Ministry of Communications and Public Works provided the use of two bull dozer tractors to clear brush and construct access roads.

Restoration was hindered by a shortage of materials. There were few materials at the start of restoration and few materials were procured during the restoration period. Hardware was difficult to salvage from the existing lines because of corrosion. A pole shortage caused Lloyd Electric to reuse substandard Wallaba poles by cutting off the decayed butts and resetting the shortened poles. Eventually poles had to be pulled from less important lateral lines for use in the primary feeder. The new poles did not arrive until a week before we left. There was a shortage of transformers that prevented restoration of power for several weeks in some areas. The needed materials had arrived on St. Kitts, but were not released to Nevis because of payment requirements.

Repair parts, particularly hydraulic hoses, were not available on Nevis. Time and travel expense were incurred in acquiring repair parts.

Terrain caused difficulties on Nevis. The digging was in hard volcanic rock and was very slow. Many holes had to be dug by using a jack hammer. Access was difficult because of both terrain and undergrowth. Conductor restoration was hindered by undergrowth and trees.

Lloyd Electric crews restored the secondary distribution in the communities of New Castle, Camps, Burnaby, Hicks, Brick Kiln, Butlers, Zion and other numerous communities. To accomplish this secondary restoration, Lloyd Electric erected another 100 poles and restored an additional 200 spans of conductor. An estimated 600 services were installed. In total, over ten (10) miles of three wire secondary was replaced. Lloyd Electric invested 44 total calendar days for the restoration of Nevis. This was 39 work days. The operation used 10 men for the first 11 days and an average of 29 men for the next 26 days. Total investment was approximately 864 twelve hour man days, or 10,370 manhours. Electricity was restored to Nevis on November 14, 1989, a little less than two months after Hurricane Hugo. Work was concluded on Nevis on November 17 and the crews were moved to Montserrat.

6. RESTORATION OF ELECTRICAL SERVICE ON MONTSERRAT

Before Hurricane Hugo, the Montserrat Electric Services Limited (MONLEC) system was reasonably maintained and much of it was only 10 years old. Danger trees had never been eliminated in the wooded areas. In the subdivision areas of Old Towne, Olveston, and Woodlands, the lines were built generally along the roads which provided good accessibility. Hugo caused extensive destruction to the MONLEC system. Systemwide pole loss was between 80 -90 percent. Many areas suffered a 100% pole loss. Over 90% of the conductor was down. Ninety-five percent (95%) of the overhead services were down.

The severity and duration of Hugo's wind would have caused a lot of distruction on an electrical system in any state of repair. Fallen trees damaged the line in many instances. Corrugated metal roofing hit the conductor and tore down adjacent poles.

The failure rate of the Wallaba poles in the system accounted for some of the losses. A pole maintenance program would have reduced losses significantly. Guy anchors, using logs instead of manufactured metal plates, failed when the anchor rods pulled through the decayed wooden anchors.

Telephone and cable television cables presented large cross sections and caused poles to break from extreme wind loading. Telephone and cable television guying was non-existent.

In the Old Towne area, what poles and conductors were left after the hurricane were completely destroyed during the road clearing operations. The conductor was cut, sometimes every 20 feet to clear the roads. Poles that simply fell across the road were cut up for road clearing. The poles with conductor attached were shoved into wooded areas with front end loaders, making conductor recovery nearly impossible.

Restoration was for an essentially totally destroyed electrical system. Plymouth was the area of least destruction. The pole loss there was about eighty (80%) percent. The tourist villa area assigned to be restored by Lloyd Electric had power distribution system losses of 100% in Old Towne, 80% in Olveston, and 70% in Woodlands. The rest of the island had losses ranging from a low of 70% to 100% in many areas.

Lloyd Electric did not arrive on Montserrat until November 18th, after St. Kitts and Nevis were restored to service. The island probably had 25% of the service restored prior to Lloyd Electric arrival. The British contingent of the British Electrical Industry (BEI), MONLEC, and the contractor, Triple W,

from Trinidad and Tobago had restored most of the services in central Plymouth. MONLEC was restoring the remainder of the services to Plymouth and to nearby areas. Triple W was just beginning to work in Salem and BEI was restoring the primary in two directions. One group was working eastward from Plymouth to the Airport area and the other group was working northward to Salem. None of the secondary lines had been restored past the Belham Bridge or outside of Plymouth city limits to the east or south.

Great Britain had contracted BEI, the same utility group that assisted in the Hurricane Gilbert Restoration in Jamaica, to provide the major part of restoration. The supervisory staff of BEI was experienced in hurricane restoration. Brian Chappelow and Tony Pringle had a well organized effort underway and BEI provided most of the material for restoration and a great deal of the planning. BEI also brought with them electrical inspectors who were responsible for the inspection of the consumer wiring. The total BEI contingent was approximately 35 men.

MONLEC and the British provided a restoration plan which had BEI restoring the 11 KV primary from Belham Valley Bridge northward to Cudejo Head and eastward from Plymouth to the Airport. The Irish team, which had been working on Antigua, was to restore the 11 KV primary line southward from Plymouth to St. Johns. MONLEC was responsible for restoration of secondary circuits and services in the Plymouth area. Triple W was restoring secondary lines and some primary lines in the Salem area.

Lloyd Electric was requested to concentrate on restoration of the low voltage (LV) distribution system of Old Towne, Olveston, and Woodlands. This area had an extensive distribution system which served approximately 400 vacation villas. Ninety percent (90%) of Montserrat's tourism income is derived from rental of the villas in these subdivisions. The only tourist hotel, The Vue Pointe, is located in Old Towne. The LV system was on the paved streets of the subdivisions so everything was easily accessible for Lloyd Electric digger derricks and bucket trucks.

By providing early restoration in these subdivisions, the economy of Montserrat would be able to benefit from some tourism in the near term.

USAID/RDO/C-OFDA/W funded Lloyd Electric on Montserrat from November 18, 1989 until January 9, 1990. This was a total of 52 calendar days with 42 work days excluding Sundays and holidays. The average manpower complement was 29 between November 18 and December 23, 1989. The manpower complement was then reduced to 14 until January 9, 1990. The project consisted of approximately 1,081 man days or 13,000 manhours. Electric service was 90% restored to the Old Towne, Olveston, and Woodlands subdivisions at the termination of the OFDA contract with Lloyd Electric. The island of Montserrat was approximately 40% restored to electricl service at this time.

At the termination of the OFDA contract, MONLEC entered into a US$400,000 contract with Lloyd Electric to continue the restoration operation for six more weeks. In order to achieve a timely restoration, MONLEC needed the manpower and equipment of Lloyd Electric. Timely restoration required the pole setting ability of the digger derricks and needed the productivity of the hydraulic bucket trucks. The Lloyd Electric contract with MONLEC terminates on February 16, 1990. With the assistance of BEI, Lloyd Electric and Triple W, MONLEC should be totally restored to electricl service by March 15, 1990.

Between November 18, 1990 and January 9, 1990, Lloyd Electric restored service to the tourist areas of Old Towne, Olveston and Woodlands. The subdivision of Old Towne had approximately 150 vacation villas and one large hotel. Because of material shortages, Old Towne was not 100% restored until December 14th. Areas of Old Towne had electricity as early as December 4, 1989. Olveston was the next subdivision to be electrified. The 175 villas of Olveston were 100% restored to service by December 23, 1989. Woodlands, a 75 villa subdivision, was only 80%

restored to service at the termination of the USAID/RDO/C - OFDA funded contract. However, Woodlands was 100% restored to service on January 16, 1990 by Lloyd Electric crews working under the MONLEC contract.

The restoration of the LV system to the three tourist subdivisions involved the erection of approximately 500 poles, replacement of 800 spans of conductor, and reinstallation of 400 service cables. Lloyd Electric put an estimated 20 miles of 4 wire secondary, or the equivalent of 80 miles of conductor, back into the air.

The restoration of electrical service allowed tourism to start again during the holidays. Seventy percent (70%) of the useable villas had power before Christmas. The Vue Pointe Hotel, the major tourist hotel of Montserrat reopened on December 23, 1989.

The well conceived and organized plan from BEI and MONLEC was a very positive factor for restoration. The plan put Lloyd Electric trucks where they could best be utilized. A general attitude of cooperation between BEI and Lloyd Electric worked to the benefit of both operations. Material availability contributed to a productive situation. The British Development Division (BDD) financed the procurement of much of the material with MONLEC also purchasing significant amounts of materials. Even though poles and materials ran short, the operation never was without material long enough to stop effective production. The Montserrat Public Works Department assisted Lloyd Electric with mechanical repair equipment facilities which helped the operation a great deal.

Some counterproductive situations were encountered during the Montserrat project. A conductor and conductor sleeve shortage was the major problem. The existing conductor had been cut into short lengths to facilitate road clearing. Replacement conductor had not arrived and compression sleeves were not available. The linemen had to make nearly one thousand hand wrapped splices in order to replace the conductor for the Old Towne circuits. Such splices will be weak points in the system.

The digging was difficult because of volcanic rock. An air compressor was procured and shipped. It reached Antigua where it was lost in shipment.

7. RECOMMENDATIONS FOR HURRICANE PREPAREDNESS

Proper line maintenance and disaster preparedness could significantly reduce hurricane damage and restoration time. Most of the following recommendations would be beneficial to Caribbean utilities even without the disaster of a hurricane.

The quality of workmanship has more effect on the durability of an electrical system than any other single factor. Nothing strengthens a line more than poles set to proper depth, which is 10% of the height of the pole plus 2 feet. Anchor plates should always be installed to a depth of 5 feet. Proper compaction of backfill for both poles and anchors is critical. Utilities should encourage workers to consider what will happen to the end product in the event of a hurricane. The utility should constantly inspect the workmanship of employees and contractors.

Caribbean electrical systems are reaching the age where pole deterioration is an overwhelming problem. Pole life in the Caribbean is limited to 20 years. This amounts to a need for a 5% annual pole replacement. Replacement of all Wallaba poles with quality pressure treated poles should be the first priority.

Adequate guying both in quantity and quality is critical. All angles of five degrees or more should be guyed. Guying should be both at the primary and secondary line levels to insure proper support of a pole. Guying is much stronger than brace poles. A pole and brace pole tend to fall together, where guying tends to hold a pole in place because tension increases as the pole moves. Anchors should be tested at installation and then again tested periodically. The testing can be easily performed with the winch of a digger derrick. If the guying and anchors endure a hurricane

and proper right of way clearing is maintained, most of the rest of the utilities' outside plant will also survive.

The joint use situation, attachment of telephone and television cables needs serious review. The telephone and cable television companies should be required to install proper guying with their attachments. A joint use specification which includes proper guying and attachment methods should be developed. Pole strength and design upgrades are often necessary to accommodate the greatly increased weight and wind loading caused by telephone and cable television lines. Minimum lateral strength requirements increase 100% for telephone attachments because of the increased wind load on the larger cross section.

'Storm guying' for critical structures should be implemented. The strength of a line can be greatly improved with very little expense by installing guys in line and laterally. Canyon crossings should always have side and in-line guying. Lines constructed in soft soil and suspected high wind areas should be 'storm guyed' at least every one half mile. By 'storm guying' 5 to 10% of the structures, a dramatic reduction in disaster losses should result.

Easement maintenance is the least expensive method to prevent outages during normal operation and to minimize conductor and pole losses during a disaster. Trees which can contact power lines should be eliminated. The elimination of danger trees, which is any tree that will reach the line when it falls, would prevent much of the damage done by high winds. Line design should attempt to place lines in accessible areas, preferably near main roads. This facilitates routine troubleshooting and maintenance. In the event of a disaster, accessible lines are much more quickly restored. Likewise, the periodic elimination of brush and undergrowth help with day to day operations and greatly expedite restoration.

Emergency material stockpiles should be maintained. Such stockpiles would need to maintain only enough material to start a restoration program. A quantity of poles amounting to 5% of the poles in the system should be stockpiled. This stock needs to be rotated to prevent decay of horizontally stored poles. Conductor should be kept in reserve for emergency use. System design should limit the number of conductor sizes to three in most instances. A quantity equaling 2% of the system should to be stockpiled. An adequate supply of service cable should also be maintained. A large stock of conductor sleeves in all sizes of conductors used should be maintained. Such reserves would not be adequate to restore a system, but they will be a great help in the initial stages of restoration.

Every electric utility in the Caribbean should have a disaster plan in place before each hurricane season. Establish the priority of loads, especially those requiring generators if restoration time were to be excessive. Typical loads to be placed on generators following a disaster are hospitals, communications facilities, airports, water systems, disaster related government services, refrigerated food storage, and ice making facilities. The kilowatt and voltage requirements of these priority loads should be determined as part of disaster preparedness.

A material order system should be prepared before the hurricane season. Timely ordering of material is very critical to a restoration program. There is a significant lag time in material procurement and after a hurricane, there is competition between affected utilities for materials needed. Material is usually shipped on a first come, first served basis. In the days immediately after a hurricane, it will be difficult to find the time for the material evaluation which will be necessary for restoration. The material ordering system should be organized so that a multiplier derived from the percent of damage can be introduced and a reasonably complete material order established.

One of the first questions donor nations will ask before providing manpower is "Are materials in place or enroute?".

Small utilities should establish a plan of cooperation between neighbors. The plan should be for manpower and material purchases from adjacent countries' stockpiles.

System mapping is very helpful in restoration. Maps are also valuable in normal utility operations. Restoration crews may not be familiar with the affected nation and primarily will not be familiar with details of the electrical system. System maps will save a great deal of time in both disaster evaluation and restoration planning. Work assignments from restoration coordinators will be more easily understood by expatriot restoration crews if maps are available. Maps will also aid in having the system restored to its original configuration. A good supply of copies should be maintained.

8. RECOMMENDED INITIAL ACTIONS FOR RESTORATION BY THE UTILITY

An evaluation of the amount of damage and the extent of system losses is the first step for restoration. This evaluation should be written and available to government officials and evaluation teams of potential donor nations. It will be necessary to update and amend this evaluation as the situation and requirements are better determined.

Several determinations should come from the initial evaluation. The first determination would be the selection of high priority facilities. The lines serving high priority facilities should be surveyed to determine the repairability of the lines. Estimated material and manpower needs should then be determined as quickly as possible.

If lines to priority facilities are not restorable in a reasonable time frame, procurement of approximate size generators

should begin immediately. Determination of the most time effective shipping method should be made and then expeditious arrangements made to have the generators shipped. Those facilities which are to be maintained on generator power should be prepared for connection prior to the generators arrival.

Road clearing often destroys line and materials that a small utility will have difficulty in replacing. Attempts should be made to place power utility people with road clearing crews for areas where there are downed lines. If manpower is available, a great deal of line can be saved by having the lines removed from the road by line personnel or at least by crew under the supervision of experienced line personnel. Most importantly, the cutting of conductor to facilitate road clearing should be kept to a minimum. Wherever possible, tie the conductor out of the road way. This can be accomplished with binding twine. Move poles from the road whenever possible rather than cutting them with chain saws. Pole supplies will probably be exhausted before pole shipments arrive. Many fallen poles can be trimmed and reused.

Material ordering must be immediate. Systems on other islands have probably been damaged and there will be competition for the available equipment and materials. When restoration starts, the need for material will be immediate. Shipping time after a disaster can be very lengthy because reconstruction materials other than line restoration materials are also being shipped. Order adequate quantities of material. Restoration takes a surprising amount of material and material will be used more quickly than one would ever expect.

If the disaster has been severe, seek help from various donor agencies. Prepare a written and accurate estimate of system losses, current material inventory, local availability of skilled labor, and the utility's financial resources. Overstatement of losses and subsequent needs causes a general discreditation of the entire report. Some areas to consider in a written request are needs for technical assistance (manpower), material, tools, equipment and financial assistance. This written request should be submitted to all possible donor agencies.

Consideration should be given to hiring an expatriot restoration coordinator. A restoration coordinator should have practical experience in extensive electrical restoration. This person would have the advantage of previously experiencing the restoration process. An expatriot would not be as easily influenced by local politics even though he would necessarily be sensitive to, and understanding of, political situations. A restoration coordinator can take significant work load from the utility manager who will still have to manage the utility with the monumental additional responsibilities associated with a major restoration effort.

The assistance of local Immigration and Customs officials should be incorporated to streamline their procedures. Customs should expedite procedures for the immigration clearance of skilled labor and movement of material, equipment, vehicles, tools and repair parts. Local taxes should be waived or donors will be offended. Assistance costs incurred by the utility or government agencies in supporting restoration operations should not be billed to the donor.

If storm damage is extensive, the hiring of expatriot contractors is usually the only option. Before the selected contractor operation is mobilized, request his field supervisor to assess the needs for restoration in the areas of manpower, tools and equipment. This will also give local utility management an opportunity to evaluate the contractor. Be sure that the contractor has experience in electric power system restoration. Be sure that he will be furnishing qualified, trained personnel and modern hydraulic equipment. Have a contract available that protects both the utility and the contractor. Be sure to make preliminary arrangements for guarantee of payment such as a bank letter of credit to allow the contractor to begin work as soon as possible.

9. OFDA/USAID INITIAL ACTIONS TO ASSIST ELECTRICAL RESTORATION

The OFDA/USAID response to the need for electrical power restoration on St. Kitts, Nevis and Montserrat was well handled once a contract was executed . The initiative taken to obtain the Lloyd Electric team from USAID/Kingston and to put them to work and restoring power was very timely. The following are suggestions which could possibly improve future restoration activities.

The initial evaluation of electrical system damage could be expedited by requesting that the affected utilities provide a brief written estimate of system damage. This could be simplified by developing a form on which facts could be indicated such as the total system size, the estimated percentage of poles lost, estimated time to repair, etc. Request that utility management arrange for someone to show an evaluation team the damaged areas. Have an experienced construction person aligned with USAID to determine system damage, equipment, material and manpower needs during evaluation. It would be best to have a consultant reporting to OFDA or USAID along with a contractor representative make the evaluations. Or, in cases where utilities are self-financing the expatriot assistance, the utility should make joint review and evaluation to determine required inputs and to agree on work plans, methods and number of men required to support utility restoration activities.

An outline of initial actions for the utility would be helpful for them in many instances. Because of the shock of the disaster, it sometimes is days before utility management begins making the proper responses to the situation. The management of small utilities can often use advice on how to quickly begin restoration work.

If a technical assistance need is determined, an independent line contractor is a much better choice than a utility. Even utilities will admit that contractors are significantly more productive in construction or re-construction situations.

Contractors have a flexible schedule while utilities have a commitment to their service areas. Contractors employ personnel who are already adjusted to an 'away from home' environment. Contractors will need to see the terrain, soil conditions, and extent of damage to determine equipment and manpower needs.

There are several requirements that the contractor should meet. The personnel furnished should be trained through apprenticeship and experience in line construction and maintenance. Equipment provided should be well maintained, modern hydraulic equipment. An air compressor and air hammers should be provided. Adequate tools should be provided. The operation will require a radio system to efficiently coordinate the activities of the different crews and activities.

Arrangements for logistic support if made by OFDA, USAID or the utility can expedite getting work forces into the field and in getting restoration underway. These logistics include lodging arrangements similar to those previously described in this paper; permission to install a radio system; arrangements for transportation vehicles; an arrangement for personnel to clear local Immigration and for equipment to clear Customs; and numerous other details specific to the situation. To the extent possible, the contractor should be consulted for his specific needs and requirements.

A Memo of Understanding should be presented to the recipient utility before technical assistance arrives. Areas of consideration include the desirability for the recipient to provide fuel for equipment, security if needed, suitable staging areas, access to easements, assistance with mechanical repairs, specified shipping costs, specialized occasional use equipment such as bulldozers when required and line construction materials to extent feasible.

OFDA should consider placing a project manager onsite throughout the project. Because of the experience and integrity of Lloyd Electric, a full time project manager was not necessary in this instance, but OFDA nor a utility cannot consistently rely on that to be the situation. Considering the cost of a restoration project, a manager should be present to monitor and document the contractor's performance. A project manager with USAID or OFDA authority could also work with recipients to encourage the timely performance of their obligations to the project. The project manager would also be in the position to serve as a restoration coordinator wherever there was a need for one.

Contracting officers should consider possibility of and the advantages of paying per diem on a reimbursement plus handling basis with a specified ceiling. This would discourage a contractor from providing a substandard food and housing situation to his personnel for the sake of making additional profit on per diem. This situation did not occur under the Hugo restoration contract, but this is a real possibility from contractors with high profit motivation. This should be a concern of OFDA, USAID and the utilities because substandard lodging and meals results in worker dissatisfaction and higher personnel turn over rates which results in loss of or substandard production.

10. CONCLUSIONS

The total time frame for the OFDA funded technical assistance to St. Kitts, Nevis and Montserrat was from September 27, 1989 until January 9, 1990. Lloyd Electric was on the project for a total of 109 calendar days.

On St. Kitts, mobilization was completed between September 27 and October 3, 1989. Technical assistance was provided to St. Kitts from October 3 to October 16, when electrical service was restored.

The Lloyd Electric crews worked on Nevis from October 3 until November 18, 1989. Service was restored to Nevis at this time.

Lloyd Electric personnel were on Montserrat from November 18, 1989 through January 9, 1990. When the OFDA contract expired on January 9, 1990, MONLEC employed Lloyd Electric to continue restoration until February 16, 1990. It is estimated that power will be 90% restored to Montserrat at that time and probably 100% restored by March 15, 1990.

As a direct result of electrical restoration in these three countries, the OFDA funding made possible the normal operation of the water systems, government services including police and fire departments, tourism, industry (light manufacturing), and retailing, including refrigeration for food. The foundation for the recovery of a normal way of life has been provided to these three islands by the restoration of the electrical systems.

The personnel of Lloyd Electric made many friends in the eastern Caribbean. A mutual respect was developed between all the donors (including other Caribbean nations) and the utility personnel. A comradery was established with fellow tradesmen from several nations.

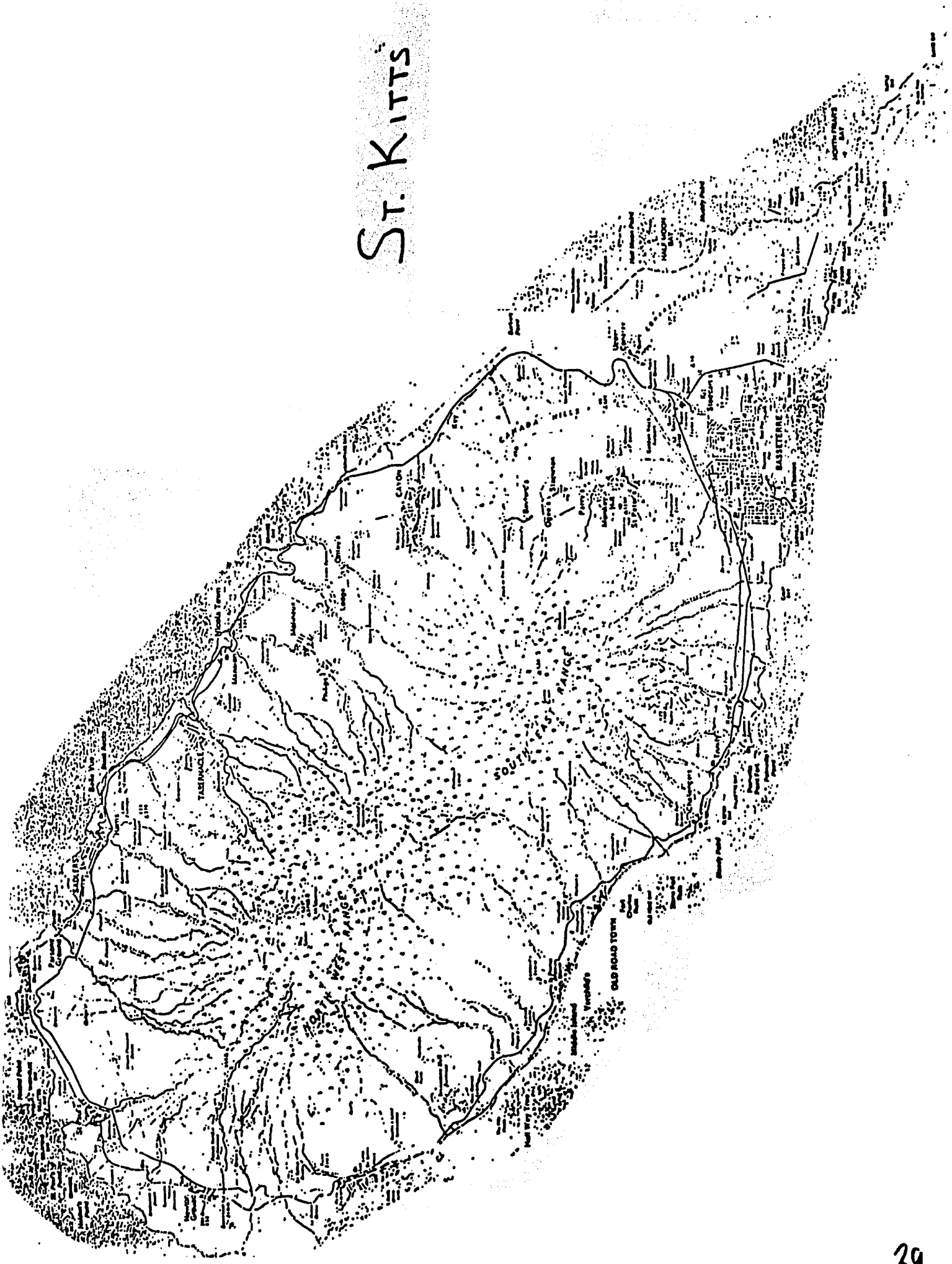
As a result of the presence of Lloyd Electric linemen, ~~presence~~, the people of these nations have had personal contact with Americans, not as tourists, but as working people. The bottom line is that the people of St. Kitts, Nevis and Montserrat watched friendly and helpful Americans working six days a week from daylight to dark to bring electricity back to their communities. Many residents were effusive in expressing their appreciation. This project has made a very large and positive impression about the United States and the U. S. linemen on these three small islands.

Restoration activities on the three islands of St. Kitts, Nevis and Montserrat were accomplished between September 27, 1989 and January 9, 1990 and utilized 2121 person days of assistance. The overall costs for labor, equipment and materials was approximately US$1,900,000.

With considerable pride we note that during the entire operation, there were no time loss injuries although the crews worked 12 hours a day, six days a week from dawn until dark.

We take this opportunity to thank the various electricity departments, the government authorities of the islands, BEI, RDO/C and OFDA for their cooperation and support.

Annex 1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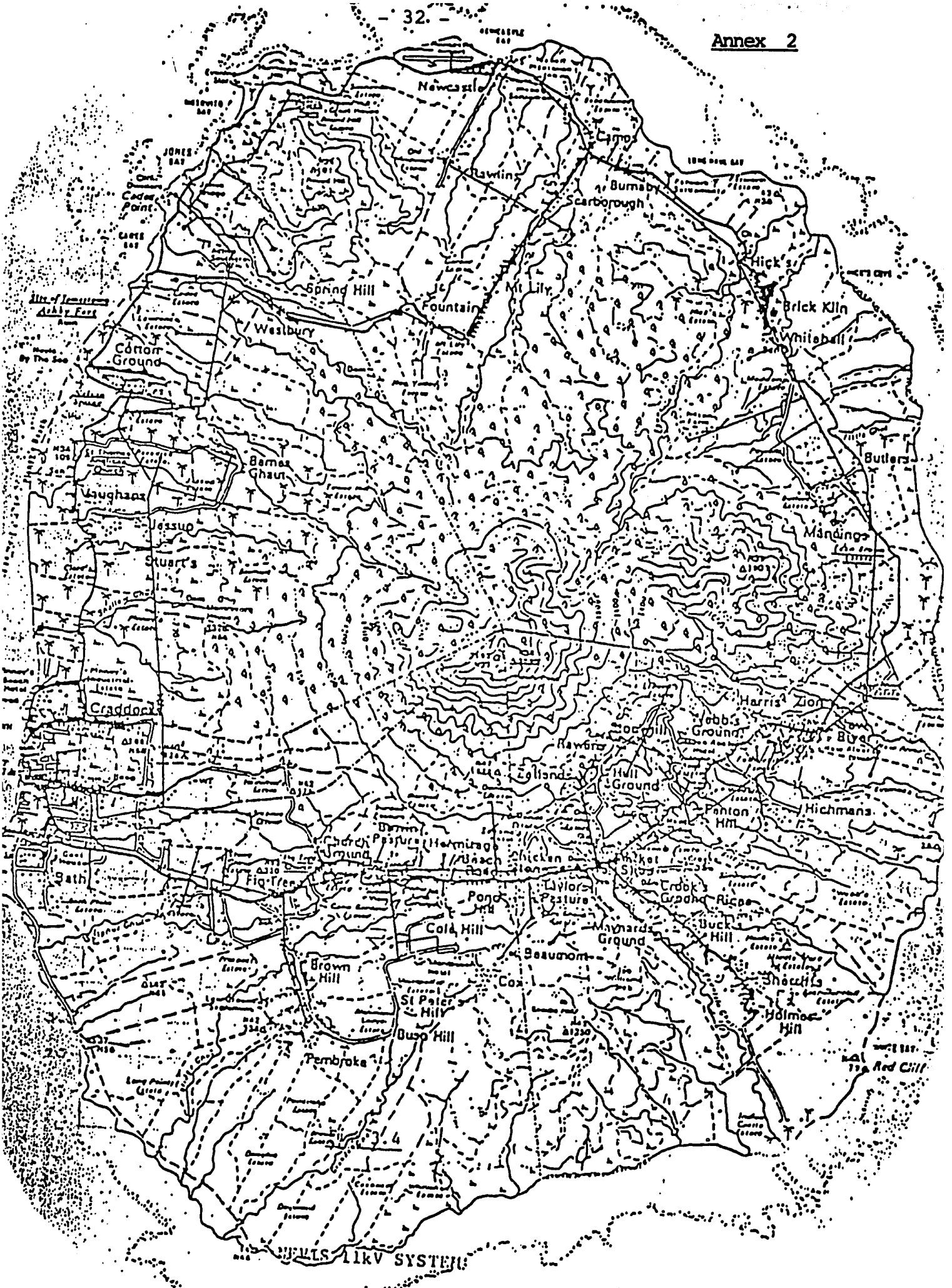
BASSETERRE
OLD ROAD TOWN
TASMANIA

Annex 2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Fountain
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Vaughans
Jessup
Stuart's
Butlers
Mandings
Craddock
Harris
Zion
Hobbs Ground
Rawlins
Collins
Hill Ground
Penton Hm
Hichmans
Bath
Fig Tree
Pond
Taylors Pasture
Maynards Ground
Cold Hill
Buck Hill
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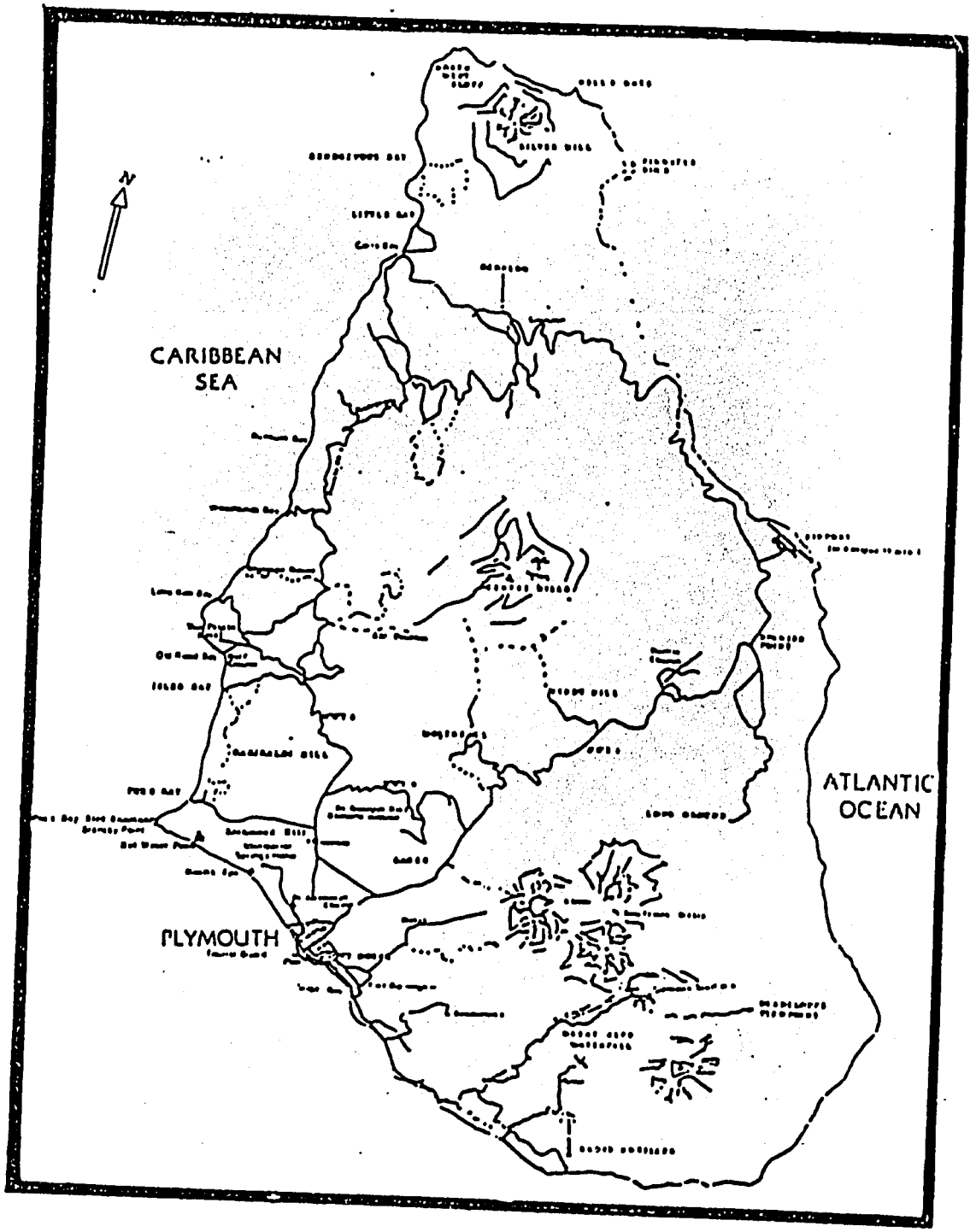
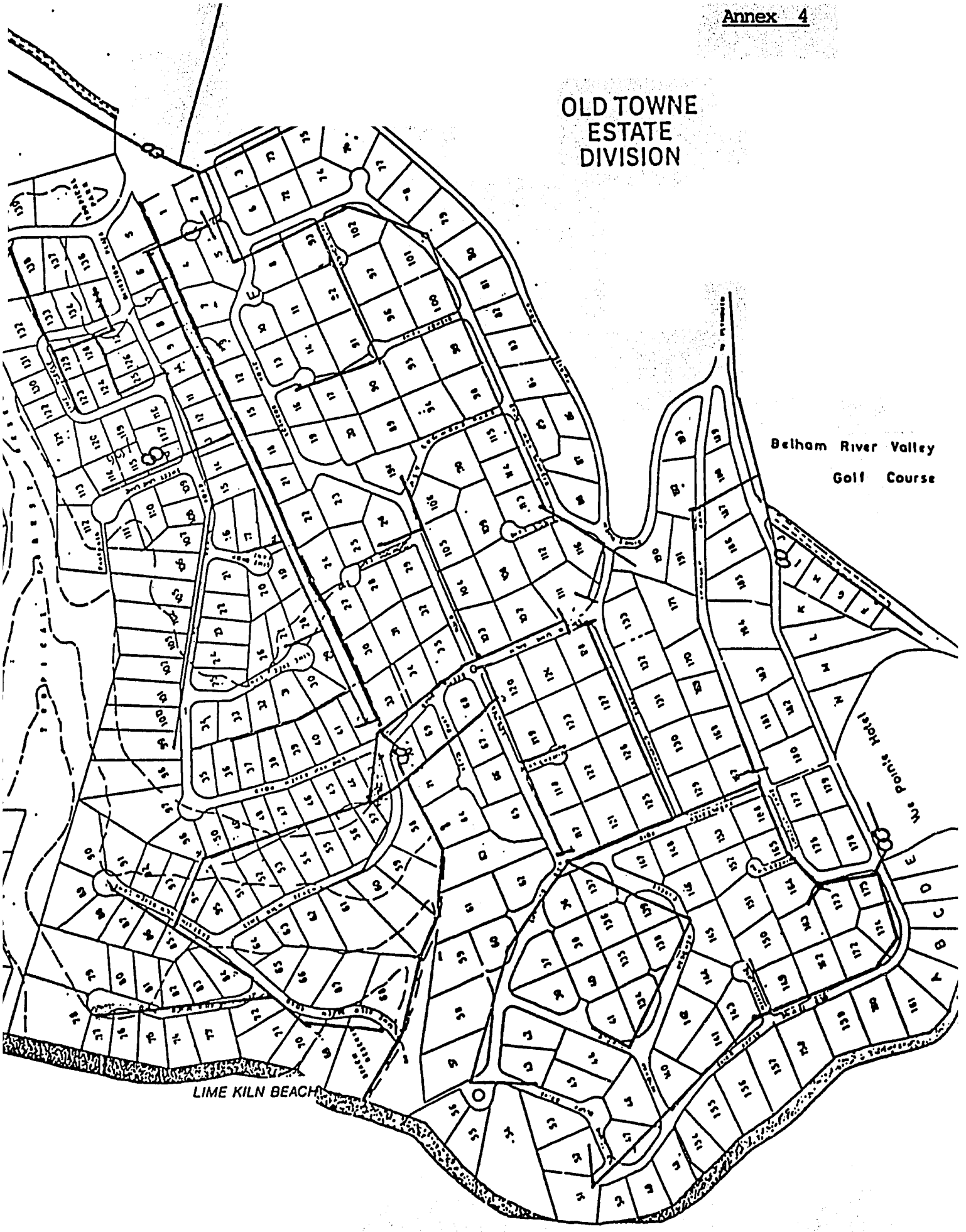
11kV SYSTEM
NEVIS
40

Annex 3



MONTSERRAT

Annex 4


OLD TOWNE
ESTATE
DIVISION
Belham River Valley
Golf Course
LIME KILN BEACH

Annex 5


OLVESTON
ESTATE
DIVISION
MAIN ROAD
PUBLIC ROAD
CARIBBEAN SEA

Annex 6


WOODLANDS ESTATE DIVISION
PRIVATE ESTATE
WOODLANDS BEACH
Lawyers River
Waterfall
Park

Annex 7

HURRICANE HUGO
POWER RESTORATION PROJECT
DAILY LOG

DATE :

LOCATION :

ACTIVITIES :

CREW NO. 1.

2.

3.

CONTACTS :

LOCATION :

ACTIVITIES :

CREW NO. 4.

5.

6.

Problems/Difficulties:

GLOSSARY

AID	Agency for International Development
BDD	British Development Division
CIDA	Canadian International Development Agency
D of E	Department of Electricity
Danger Tree	Any tree which if it fell would strike or interfere with a power line
Digger Derrick	Combination purpose truck with hydraulic power auger, crane boom and aerial bucket attachment
JPS	Jamaica Public Service Co., Kingston, Jamaica
KV	Kilovolt = 1000 volts
LV	Low Voltage
MONLEC	Montserrat Electricity Services Limited
OFDA/W	Office of Foreign Disaster Assistance of the Agency for International Development in Washington, D.C.
RDO/C	Regional Development Office for the Caribbean in Bridgetown, Barbados
Staging Area	Storage area for keeping mobile equipment at night and for storage of construction materials
	United States Air Force