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FINAL REPORT

for

OTEC RAISER CABLE AT

PUNTA TUNA, PUERTO RICO

SIMPLEX WIRE AND CABLE COMPANY

Portsmouth, New Hampshire

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

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CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

of the

University of Puerto Rico

College Station

Mayaguez, Puerto Rico 00708

FINAL REPORT.

for

OTEC RAISER CABLE AT

PUNTA TUNA, PUERTO RICO

SIMPLEX WIRE AND CABLE COMPANY

P.O. Box 479

Portsmouth, New Hampshire 03801

Mie: Date: ___25 March, 1381 _

Prepared by:

Me, Thomas Margan

Indpection Investigajor

ee OD

Avprovea by: AA J

r. Donald S- Sasscer

Director, OTEC

Date: _25 March, 1961 _

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Corrosion Observation

Macrofouling Identification.

Photographs. ..-

Buoy 2, Depth 200' Erosion Observation,

Corrosion Observation. .

Macrofouling Identification.....

Photographs.

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Background

On December 3, 1979, the Center for Energy and Environmental Research was contracted by Simplex Wire and Cable Company to ?Conduct a site specific, corrosion and biofouling test on eight different marine riser cable coverings. The cable coverings were mounted on racks and suspended from the CEER-OTEC research platform moored at a potential OTEC site two miles off the southeast coast of Puerto Rico (Fig. 1).

Four sets of racks, each containing the eight coverings to be

1e had one

tested, were deployed from two different lines. Each set of racks at a depth of 25 feet and one set of racks at a depth of 200 feet (Fig. 2). The arrangement of the samples on the racks is ?shown in figure 3.

?The racks were deployed on 13 and 18 May 1980. Inspections of the samples and of the lines which supported the racks were made on 25 June, 4 August, 10 September, 31 October 1980, and 20 6 21 January 1981. The racks were not redeployed following the January 1981 inspection since DOE funding for the research platform was terminated. A report

fon the 25 June inspection was sent to Simplex on 16 July 1980.

CEER received no funding from Simplex during the summer, no reports fon the August and September inspections were submitted. This final report includes inspection forms and photographs from the October, 1980 and January, 1981 inspections.

During inspections, samples were out of the water for 30 to 60 minutes and were regularly wetted to prevent them from drying out. ?The only ?exception to this was for the August inspection. Due to the approsch of hurricane Allen, the samples were left out of the water from noon on

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Figure 1 Map of Puerto Rico showing location of the CEER-OTEC research platform,

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Figure 2 Diagram of experimental

rack deployment

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Figure 3 Arrangement of cable samples

on experimental racks.

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Recanggement oF calle semges on

eageormental cadks

hie

20! R00"

T T rT |

wa doa wr toa

par ys ps | 8

L L roto

T T Toy yO

+ V2 3 u

| 8% | 15

1 1 1 1

Lowe 2

Oo 200%

T | T T | T

1 q 2 10

Ls 3 6 ?

1 1 1

T | Tm T | T

up | 20 a | 38

| Ab 7 ad 120

1 1 4 1

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4 August to 1700 on § August.

Following the October inspection, an underwater inspection

showed that the racks had been redeployed properly. That evening

Tine #1 parted at a depth of 85 feet. The cut was clean and not frayed

?as it would have been if it had been caused by chafing.

Conclusions

The tar on sample #12 appeared to be cracking on the first

inspection. However, this condition did not worsen and there was no

evidence of erosion on any of the other coverings.

Gorrosion

With the exception of the copper-nickel coverings, none of the

samples showed any evidence of corrosion. In October, some superficial

pit

ng of the surface of the copper-nickel covering was evident. By
January, there was considerable pitting of the surface of these samples.
Pitting of the copper-nickel samples in deep water appeared to be
less severe than that of the samples in shallow water.

Macro~Biofouting

As would be expected, there was little biogrowth on the
copper-nickel samples. There was some growth on the cloth which

covered half of the copper-nickel samples and the hydroid Ob:

was able to live in the crevices between the ribbons of metal, but
With the exception of amphipods no organisms colonized the metal
surface of the copper-nickel.

There was no noticeable difference between biofouling on any of
the tar-covered or string-covered samples. For this reason, biofouling

organisms for these coverings are lumped together on the inspection

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form. What we saw on the shallow samples was the successional development of a biofouling community. Initially, they were colonized by few species ~ mainly the hydroids Obelia and Halocordyte and the filter feeding amphipod Podocerus. With time, the communities . became more complex. Algae became more and more predominant, three more amphipod species appeared, and species of sponges, anemones, polychaetes, melluxs, siptnculids, bryozoans, and ascidians were a

part of the diverse commur

'y which had developed by the end of the experiment. On the deep samples, species diversity of the fouling community was considerably tess.

1 is doubtful that any of the organisms encountered could affect the coverings adversely. Some of them adhered to the surface of the coverings while others moved freely along the coverings, but there was no evidence that any of them caused erosion or other damage to the

coverings.

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SPECIES IDENTIFICATION

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SPECIES IDENTIFICATION

Kingdom Animalia

Phylum Poriters

Seypha sp.

Phylum Cnidaria

Class Hydrozoa

Halocordyle disticha (Goldfuss)

Obetia sp

Plumulari

sp.

Class Anthozoa

Aiptasiogeton sp.

Phylum Annelida

Class Polychaeta

Filograna sp.

Hydroides sp.

Phylum Mollusca

Class Gastropoda

Alabe incerta Orbigny

Gerithium eburneum Sruguiere

Class Pelecypoda

Au

seminuda Lamarck

Musculus lateralis Say

Pinctada radiata Leach

Phylum Arthropoda

Class Crustacea

Subclass Cirripedia

Conchoderma sp.

---Page Break---

Lepas sp.

Subclass Malacostraca

Order Amphipoda

Elasmopus pocitlimanu

Podocerus

Stenothoe crenulata Chevreax

unidentified caprettia

Phylum Sipuculida

1 unidentified species

Phylum Bryozoa

2 unidentified species

Phylum Chordata

Subphylum Urochordata

Class Ascideacea

Diplosoma macdonatdi Herdman

Herdmania momus (Savigny)

---Page Break---

RESULTS,

June 1980

---Page Break---

16 suly 1980

Mr. Jeffrey P, Kurt

Development Engineer

Simplex Wire and Cable Company

P. 0, Box 479

Portsmouth, New Hampshire 03801

Dear Mr. Kurt:

On 25th June, the Simplex cable samples were renoved from the water and examined. Inspection forms and photographs of the samples are enclosed. The fouling organisms mentioned were sampled but have not yet been identified beyond @ general classification.

Sincerely yours,

Temas Mero

?tH/ee Thomas Morgan

Enclosure Senior Associate

ce: Dr. Donald 5. sasscer

w/encl.

MaluINGs ADDRESS CENIER FOH ENERGY AND ERVIRGRVENT RESEARCH COLLEGE STATION MAVAGUEZ PUEATO RICO 0708

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-li-

SINPLEX CABLE EXPERINENT Page 2 of 2

MONTHLY INSPECTION FORM

Buoy (1) 2 DATE__g-25-09

DEPTH 25" (200°) ?Ime ovn___ 1320

Imsprcror ___Morgan Time im 3345

SAMPLE EROSION corsosion | _arorourrnc

3 Nowe roxe Hydroids (<58 cover)

7 Nove now, Hydroia (308 cover)

a Nowe nox Hydroid (5-108 cover)

15 Nowe one, Hydrose (508 cover) ;

ae Nowe, Superfseia1 None

Sone oxidation

22 Nowe Slight corrosion} Noe

at seams

25 Nowe Nowe Bydrosa (508 cover)

a7 NONE, NONE Hydroia (50% cover) '

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15.

SIMPLEX CABLE EXPERIMENT

i

&

MONTHLY INSPECTION FORM,

puoy 1 (2) DATE___ 6-25-80 _

DEPTH (259 200" ?Tine ovr__1410

INSPECTOR _ Morgan ?TIME IN 1450

SAMPLE & EROSION CORROSTON BIOFOULING _

1 Noe, NONE, Hydroids (50t cover)

Amphipods (numerous)

5 Nowe now Hyaroids (50% cover)

Amghipods (numerous)

9 woe, none, Hydroids (708 cover)

Anphipods (nurerous)

Polychaete (13)

B None NONE, Hydroids (708 cover)

Japhipods (numerous)

Polychsete (13)

? Nose, lsone superficial | Nowe

loxidation

20 Nowe, [Slight corrosion | Hydroids (5-108 cover)

lat Seams

26 None None Bydroids (108 cover)

Macro-algae (<1% cover)

Japhipods (numerous)

us Noe None Hydroids (708 cover)

Macro-algae (<Tt cover)

Anphipods (nunerous)

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Pose 4 of ¢

MONTHLY INSPECTION FORM

poy 2 (2) DATE, 580

DEPTH 25" (200" mime our__. 1440

INSPECTOR ___Yorgan rime IN 1510

SAMPLE # EROSION coRRosz0N BIOFOULING

2 vere: nae piyaroids (408 cover)

6 noe none hydrotds (408 cover)

20 none none ByGroids (508 cover)

4 noe none Hyaroids (50% cover)

2 NOE some superficial | none

oxidation

24 noxe Sight corrosten | syaroies (5-208 cover)

28 noe yon Hydroids (508 cover)

120 noe yo Hydroids (508 cover)

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October

1980

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-25-

SIMPLEX CABLE EXPERINENT

Page

MONTHLY INSPECTION FORM

puoy 12 DATE_31 October 1980

DEPTH 25" 200" TIME ouT_1230

INSPECTOR _Thomas Morgan TIME IN _ 1300

SAMPLE & CORROSION BIOFOULING

4 None None ?See Detailed Analysis,

8 None None nme

2 None None sons

16 None None ee

19 None Shallow pitting amphipod

2B None cover turn some hydroid, algae, amphipod on

?shallow pitting cover

7 None None See Detailed Analysis

ug None None oe

---Page Break---

2)

DETAILED ANALYSIS

Buoy:

Depth: _2st

Date: __31 October 1980

Biofouling on samples 4, 8, 12, 16, 27, 119

algae 80 $ cover

Cladophora algae dominant

Heterosiphonia

Microcoleus

Polysiphonia

bryozoan

rs son

Plumularia

?sea anemone occasional

Aiptasiogeton

serpulia worms several per sample

amphipod numerous

Podocerus,

?Stenothoe

bivalve occasional

a

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~ 2325

SINPLEN CABLE EXPERINE Page

MONTHLY INSPECTION FOR!

Buoy 1 2 DATE 31 October 1980

DEPTH 25! 200" rime ovr_0950

INSPECTOR Thomas Morgan TIME IN _1030

SAMPLE t EROSION ?coRRosTON BIOFOULING

1 None None See Detailed Analysis

s None None ss

° None None see

3 None None sone

7 None ?shallow pitting None

20 None cover gone ~

?shallow pitting None

26 None None See Detailed Analysis

8 None None ss .

---Page Break---

2335

DETAILED ANALYSIS

Biofouling on samples 1, 5, 9, 13, 26, 118

alagae 80 & cover

?Cladophora algae dominant

Ricrocoleus

Polysiphonia

bryozoan

ascidian

Plumularia

anemone occasional

?Aiptasiogeton

serpulid worm several per sample

Filograna

Aydroides

bivalve occasional

Pinctada

amphipod numerous:

Podocerus

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SIMPLEX CABLE EXPER?

MONTHLY INSPECTION FORM

Buoy 1 2 pare _31 October 1980

pePTH 25! 200" ?Time ovr_1300

INSPECTOR Thomas Morgan TIME IN __1530

MENT Page _

sampue + | __ EROSION CORROSTON BIOFOULING

3 None None ?A 808 cover

© few

numerous

7 None None A 80% cover

© few

D numerous

" None None A 20% cover

c few

D few

Eo

8 None None ?A 60% cover

B < 5t cover

c few

numerous

18 None shallow pitting A in crevice

2 None Icover torn

Ishalfow pitting

25 None None A 80% cover,

few

D numerous

n7 None None A 60/ cover

© few

D numerous

A. hydroid Obel

B. hydroid Halodord

?. Stepulid wordy Hydroides, rat

D! amphipod Podocerus, Stenothoe, chprel

E. gooseneck bapnacle Lepas

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SIMPLEX CABLE Page

MONTHLY INS!

puoy 1 2 DATE_31 October 1980

DEPTH 25° 200" TIME OUT_1030 _

INSPECTOR _ Thomas Morgan TIME IN 115

SAMPLE $ EROSION corrosion _| __BrorouLlns

2 None None A 808 cover

C few

D numerous

6 None None ?A 208 cover

C few

D few

Et

10 None None ?A208 cover

C few

D few

uw None None ?A 808 cover

few

D numerous

a None shallow pitting C few

24 None Cover torn C few

shallow pitting

28 None None A 208 cover

C few

D few

120 None None A 308 cover

B<t

C few

D few

A. hydroid Obelia

B. hydroid Halocordyle

C. Serpulid worm llydroides, Filograna

1D. anphipod Podogerus, Stenothoe, cajrellid

E. gooseneck Barri

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RESULTS

January Inspection

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January

1981

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CABLE EMPERINENT

MONTHLY INSPECTION FORM

Buoy ot 2 DATE 20 Janus

perma 25" 200° SINE OUT,

INSPECTOR _ Thomas Morgan TIME IN

SAMPLE & EROSION CORROSION BIOFOULING

? None None See Detailed Analysis

8 None None moe

2 None None se

16 None None some

1? None considerable amphipod (numerous)

Podocerus

23 None cover torn

considerable pitting

? None None See Detailed Analysis

ns None None sme

---Page Break---

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DETAILED ANALYSIS

Buoy: 162

Depth:

Date: _20¢ 21 January 1981

Biofouting on samples 4, 8, 12, 16, 27, 119

1, 5, 8,'13,'26, 118

algae 100 § cover

?Antithamnion algae dominant

Chondria

Dass

Heicrosiphonta

Neomeris

Polysiphonia

Speraothorinion

nya

Plumularia

bryozoan

ascidian

Diplosoma

sponge several per sample

?Seypha :

?Aiptasiogeton

serpulid worm several per sample

Filograna

Hydrides

?gastropod several per sample

?Alaba

Cerithium

bivalve occasional

?trina

Musculus, 1

amphipod numerous i

Etbemopus

sipunculid few per sample

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BS

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Page

Buoy 1 2 DATE__21 January 1981

pepTH _25¢ 200° IME OUT _

INSPECTOR _ Thomas Morgan TIME IN

SAMPLE & EROSTON CORROSION BIOFOULING _

1 None None See Detailed Analysis

5 None None ?#8

9 None None noe

a None None vee

uv None considerably pitting, amphipod (numerous)

Podocerous

20 None cover gone Stenothoes

considerable pitting

6 None None See Detailed Analysis

ne None None oe

---Page Break---

~b7-

DETAILED ANALYSIS

Buoy: 162

Depth: 25!

Date: _20 6 21 January 1981

Biofouling on samples 4, 8, 12, 16, 27, 119

11,5, 9, 13, 26, 118

algae 100 & cover

?Antithamnion algae dominant

basys

Merowieas

jamerls

Sperrothamion

nara

Plumularia

bryozoan

Diplosoma

sponge several per sample

?Seypha

?Aiptasiogeton

serpulid worm several per sample

Filograna

Hyavoides

?gastropod several per sample

?Alaba

bivalve

?Atrina

Musculus

amphipod pumerous

Elasmopus,

Pouocerus

?Stenothoe

Saprelid

sipunculid few per sample

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SIMPLEX CABLE ENPERIN Page

MONTHLY INSPECTION FORM

poor 1 2 DArE_21 Jonuary 1981

DEPTH 25" _200" rime our

twspecron _ Thomas Morgan mms mm

an aay aayary

sais ¢ | __ERoszow connostoN BIOFOULING _

2 None None See Detailed Analysis

? None None sone

10 None None none

1" None None nome

n None considerable pitting amphipod

Podocerus

a None Jcover gone

Jconsiderable pitting

28 None None See Detailed Analysis

120 None None sone

---Page Break---

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DETAILED ANALYSIS,

Buoy:

Depth: _200!

Date: __20 January 1981

Biofouting on samples 2, 6, 10, 18, 28, 120

hydroid 1008 cover

Halocordyle

bel

few per sample

few per sample

bivalve occasional

?Atrina

gooseneck barnacle occasional

Lepas

amphipod several per sample

Podocerus

Stenothoe

faprellid

ascidian 1 specimen

Herdmar

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18 NV

or

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