

US EPA ARCHIVE DOCUMENT

CATALOG DOCUMENTATION
EMAP- ESTUARIES PROGRAM LEVEL DATABASE
LOUISIANIAN PROVINCE 1991-1994
FISH/INVERTEBRATE SPECIES DATA

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1. DATA SET IDENTIFICATION

1.1 Title

EMAP- Estuaries Province Level Database
Louisianian Province
Fish and Invertebrate Species Abundance Data

1.2 Catalog Author

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Tom Heitmuller, U. S. Geological Survey - BRD/GBPO

1.3 Catalog Revision Date

March 4, 1999

1.4 Data Set Name

FISHSPEC

1.5 Task Group

ESTUARIES

1.6 Data set identification code

00046, 00086, 00126, 00166

1.7 Version number for a data set

001

1.8 Requested acknowledgment

If you plan to publish these data in any way, EPA requires a standard statement for work it has supported:

"Although the data described in this article have been funded wholly or in part by the U.S. Environmental Protection Agency through its EMAP Estuaries Program, it has not been subjected to Agency review, and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred."

2. INVESTIGATOR INFORMATION

2.1 Principal Investigator

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2.2 Sample Collection Investigator

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2.3 Sample Processing Investigator

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2.4 Data Analysis Investigator

Virginia D. Engle
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2.5 Additional Investigators

N/A

3. DATA SET ABSTRACT

3.1 Abstract of the Data Set

The Fish/Invertebrate data file is a synopsis of various averages for each species collected from successful standard trawl(s) conducted at a station. The total counts of individuals, pathological observances and mean lengths for each species caught in the standard trawl(s) are reported.

3.2 Keywords for the Data file

Species, length, pathologies.

4. OBJECTIVES AND INTRODUCTION

4.1 Program Objective

The Environmental Monitoring and Assessment Program (EMAP) was designed to periodically estimate the status and trends of the Nation's ecological resources on a regional basis. EMAP provides a strategy to identify and bound the extent, magnitude and location of environmental degradation and improvement on a regional scale based on randomly located station sites. Only the randomly located Base Sampling Sites were included in this data set.

4.2 Data Set Objective

The objective of the Fish/Invertebrate Species data file was to collect information to characterize nektonic assemblages in the estuaries of the Louisiana Province.

4.3 Data Set Background Information

Estuarine nekton have economic, recreational, and ecological value. Abundant nektonic organisms, particularly in communities characterized by multiple species and feeding type, suggest a productive estuarine food web. Several subsets of nekton were selected for the EMAP-Estuaries fish community profile: finfish; blue crab; and brown, white and pink shrimp.

Finfish are particularly good candidates for use as potential indicators of estuarine condition. Most fish ecologists agree that the assemblage of fish that occurs at a sampling site is affected by water and sediment quality parameters and habitat conditions. Because of their longevity and dominant position at the upper end of the food web, fish responses integrate many short-term and small-scale environmental perturbations. Fish are known to respond to most of the major environmental stressors of concern in estuaries, including eutrophication, habitat modification and pathogenic or toxic contamination. Since the blue crab and shrimp are significant to the Gulf Coast economy, these shellfish species were selected to determine if environmental stressors that may or may not affect the finfish community would have the same affect on these valuable fisheries.

A major purpose of evaluating fish/invertebrate community composition was to determine whether regional information on fish and invertebrate community characteristics could be used as an indicator of environmental quality.

4.3 Summary of Data Set Parameters

The raw data for species composition and abundance were recorded in the field after the completion of each successful standard trawl. Fish or invertebrate target species were preserved for tissue chemistry or reference pathology analysis. All fish observed to have pathological defects were preserved for detailed histopathological examination.

4.4 Summary of Data Set Parameters

The raw data for species composition and abundance were recorded in the field after the completion of each successful standard trawl. Fish or invertebrate target species (Table B-1 Appendix B) were preserved for tissue chemistry or reference pathology analysis. All fish observed to have pathological defects were preserved for detailed histopathological examination.

4.5 Year-Specific Information about Data

In 1991, only one fish trawl was designed into the station sampling schema. Occasionally, however, circumstances prevented the completion of one successful trawl resulting in no fish collection data or tissue chemistry samples for that particular station. Beginning in 1992, the Louisiana Province allowed for up to three fish trawls per stations and averaged the indicators between the first of two successfully completed trawls. This increased the chances that nekton specific data would be more accurately represented and tissue chemistry samples would be available for each site. Occasionally, however, a field crew would conduct more than three (3) trawls in order to obtain enough tissue samples for chemistry analysis. Any trawl conducted after the first three (3) attempts was not used for any of the summary calculations. The actual number of trawls taken for each stations is reflected in the Fish Abundance data file.

For sampling years 1991-1994, the finfish, spot, (*Leiostomus xanthurus*) were collected and preserved to be used specifically as reference histopathology samples.

5. METHODS

5.1 Data Acquisition

5.1.1 Sampling Objective

Conduct successful standard fish trawl(s) at a Sampling Site suitable for the characterization of fish species composition, abundance and length.

5.1.2 Sample Collection Methods Summary

A balloon trawl (funnel-shaped net) was deployed from the sampling vessel using a hydraulic powered boom and winch system and dragged over the bottom in the general vicinity of the sampling station to capture bottom and near-bottom fishes and crustaceans. The duration of a trawl was 10+-2 minutes and the rate of speed over bottom was 2-3 knots. Following a successful trawl, the net was hauled aboard and the catch was released into a plastic trough or fish sorting table.

All fish and invertebrates of interest were sorted and identified to species and a total count taken for each species. Up to 30 individuals of a given species were measured to the nearest 0.1 cm - fork length (when applicable or overall length for fishes; tip of rostrum to tip of telson for shrimp; and carapace width (spine to spine) for crabs. The pertinent fish data were recorded on preprinted, standardized field sheets (Fish Data Sheets) for later transcription into the field computer system.

5.1.3 Beginning Sampling Date

09 July 1991
08 July 1992
06 July 1993
06 July 1994

5.1.4 Ending Sampling Date

10 September 1991
11 September 1992
19 August 1993
15 September 1994

5.1.5 Sampling Platform

Each team was supplied with a 25-foot SeaArk work boat equipped with a 7.5 L gas engine fitted with a Bravo outdrive, an "A" frame boom assembly and hydraulic winch. On-board electronics consist of: a Loran C unit, GPS (beginning in 1993), radar unit, 2 VHF radios, cellular phone, compass, a depth finder, a tool kit, and all required and suggested safety equipment. One completely outfitted spare boat was stored at the Field Operations Center (EPA Lab) as backup.

5.1.6 Sampling Equipment

The net used was a 4.9 m (16 ft) -wide, balloon (high profile) trawl with 2.5 cm (1 in) stretched mesh in the bosom, wings, and cod end; no liner was used. The trawl was equipped with 41 X 76 cm (16 X 30 in) wooded doors.

5.1.7 Manufacturer of Sampling Equipment

5.1.8 Key Variables

5.1.9 Sampling Method Calibration

The sampling gear did not require calibration. It required inspection for tears and proper assemblage.

5.1.10 Sample Collection Quality Control

A trawl was considered void if one or more of the following conditions occurred:

- 5.1.10.1 A ten (10) minute tow could not be completed because of hangdown, boat malfunction, vessel traffic, or major disruption of gear. However, a tow was considered acceptable if it was necessary to retrieve the net after at least eight minutes due to impending hazards, as long as the net was retrieved in the standard manner.
- 5.1.10.2 Boat speed or speed over the bottom was beyond the prescribed, acceptable range.
- 5.1.10.3 The cod-end of the net was not tied shut.
- 5.1.10.4 The trawl continued for more than twelve minutes or less than eight minutes.
- 5.1.10.5 The net was filled with mud or debris.
- 5.1.10.6 A portion of the catch was lost prior to processing.
- 5.1.10.7 The tow wire, bridle, headrope, footrope, or up and down lines parted.
- 5.1.10.8 The net was torn in a way that may have significantly altered the efficiency of the net.

If, due to repeated snags, a successful trawl could not be performed within 1 1/2 hours of starting, no further attempts were made and the Field Operations Center was notified.

If the trawl was successful and fish were caught, the specimens designated for chemistry or pathology analysis were contained appropriately for shipping to various labs. Each species of fish for a particular station were tracked using a barcode system. As the field crew prepared the specimens for shipping, the fish would be grouped by species and type of lab analyses needed then tagged with a waterproof barcode label bearing a unique identification number. A duplicate barcode was placed on the appropriate data sheet. Each barcode label was scanned into a datafile using laser barcode readers. This method of tagging provided the EMAP-E team an efficient, accurate and viable accounting of fish shipped to laboratories for further analysis. The laboratories were also supplied with barcode readers so fish received by lab personnel could be documented. The lab receiving files were electronically forwarded to EMAP-E for shipping and receiving reconciliation.

5. 1. 11 Sample Collection Method Reference

Macauley, J. M. 1991. Environmental Monitoring and Assessment Program-Near Coastal Louisiana Province: 1991 Monitoring Demonstration. Field Operations Manual. EPA/600/X-91/XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. 1992. Environmental Monitoring and Assessment Program Louisiana Province: 1992 Sampling: Field Operations Manual. EPA/ERL-GB No. SR-119. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. 1993. Environmental Monitoring and Assessment Program Louisiana Province: 1993 Sampling: Field Operations Manual. EPA/ERL-GB No. SR-XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. 1994. Environmental Monitoring and Assessment Program Louisiana Province: 1993 Sampling: Field Operations Manual. EPA/ERL-GB No. SR-XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

5. 1. 12 Sample Collection Method Deviations

None

5. 2 Data Preparation and Sample Processing

Sample processing methods not applicable for estimates of fish/invertebrate species composition and abundance.

5. 2. 1 Data Preparation Objective

N/A

5. 2. 2 Data Processing Methods Summary

5. 2. 3 Sampling Processing Method Calibration

N/A

5. 2. 4 Sample Processing Quality Control

N/A

5. 2. 5 Sample Processing Method Reference

N/A

5. 2. 6 Sample Processing Method Deviations

None

6. DATA MANIPULATIONS

6.1 Name of New or Modified Values

FSPECABN	Taxon Abundance (#/sample)
FSPEC_CM	Mean length (cm) of all Individuals
FSPECSTD	Standard Dev. of Length (cm)
FSPECBOD	# Body Path. on Ind. of the Taxon
FSPECBRN	# Body Path. on Ind. of the Taxon
FSPECBUC	# Body Path. on Ind. of the Taxon
FSPECOCU	# Body Path. on Ind. of the Taxon
FSPEC_MA	Mean abundance by Taxon

6.2 Data Manipulation Description

Data are calculated such that results appear on a taxon basis.

6.3 Data Manipulation Examples

6.3.1 Mean Length of individuals of a taxon

FSPEC_CM represents the mean length (cm) of all Individuals of a Taxon. Sum of all lengths of a taxon / total # of individuals of a taxon collected in the fish trawls.

6.3.2 Standard Deviation of the Mean Length

FSPECSTD represents the Standard Deviation of the Mean Length. A standard deviation was calculated when there was more than one length for a taxon.

6.3.3 Abundance of a Taxon

FSPECABN represents the sum of the abundances of all individuals for a specific taxon in the successful trawl(s) at a station at a sampling site.

6.3.4 External body pathologies

FSPECBOD represents the number of individuals with gross external pathologies related to body surfaces for each unique species retrieved during the fish trawls. Pathology classification includes observable hemorrhages, discoloration, cloudiness, parasites, ulceration, lumps/bumps, white spots, fin erosion, and musculoskeletal abnormalities. Fish identified to have any body pathologies are saved and preserved for histopathological analysis.

Finfish exhibiting signs of external parasitic isopods without any additional indications of gross pathologies are generally not kept for pathology analysis. Historically, the pathology results do not support any evidence that these particular parasites adversely affect the overall health of a fish. However, the fact that these isopods existed is noted on the field data sheet.

6. 3. 5 External branchial pathologies

FSPECBRN represents the number of individuals with gross pathologies related to the Gills and Gill chamber for each unique species recovered from fish trawls. Pathology classification includes observable lumps/bumps, ulceration, parasites and gill erosion. Fish identified to have any branchial pathologies are saved and preserved for histopathological analysis.

6. 3. 6 External buccal pathologies

FSPECBUC represents the number of individuals with gross pathologies related to the mouth cavity for each unique species retrieved during fish trawls. Pathology classification includes observable lumps/bumps, ulceration and parasites. Fish identified to have any buccal pathologies are saved and preserved for histopathological analysis.

6. 3. 7 External ocular pathologies

FSPECOCU represents the number of individuals with gross pathologies related to the eyes for each unique species retrieved during fish trawls. Pathology classification includes observable depression, popeye (not related to trawling activities), hemorrhages and cloudiness. Fish identified to have any eye pathologies are saved and preserved for histopathological analysis.

6. 3. 8 Mean number of individuals per taxon

FSPEC_MA represents the mean number of individuals for each taxon per trawl at a station. This field is calculate as: total abundance / # of trawls taken at sampling site.

6. 4 Data Manipulation Computer Code File

6. 5 Data Manipulation Computer Code Language

6. 6 Data Manipulation Computer Code

7. DESCRIPTION OF PARAMETERS

7. 1 Description of Parameters

7. 1. 1 Parameter Name

Field Name	Data Type	Max Field Len	Format	Variable Field Label
STA_NAME	Char	8	\$8.	The Station Identifier
SPECCODE	Char	8	\$8.	The EMAP Taxon Code
FSPEC_CM	Num	8	6. 2	Mean Length (cm) of Ind. of the Taxon
FSPECSTD	Num	8	6. 2	SD of Mean Length
FSPECABN	Num	8	6.	Ind (#) Collected of the Taxon
FSPECBOD	Num	8	4.	# of Body Path. Per Taxon

Field Name	Data Type	Max Field Len	Format	Variable Field Label, continued.
FSPECBRN	Num	8	4	# of Branchial Path Per Taxon
FSPECBUC	Num	8	4	# of Buccal Path. Per Taxon
FSPECOCU	Num	8	4	# of Eye Path. Per Taxon
FSPEC_MA	Num	8	8.2	Mean # of ind. Per Trawl
VST_DATE	Num	8	YYMMDD6.	The Date the Sample was Collected
QA_CODE	Num	8	\$8.	QA Code for Fish Trawl

7. 1. 6 Precision to which values are reported

Means and standard deviations are reported to 2 decimal places. All other variables are reported as integers.

7. 1. 7 Accuracy of the data values

7. 1. 8 Minimum Value in Data Set

1991
1992
1993
1994

FSPECABN
0
0
0
0

FSPEC_CM
3.2
2.5
2.2
2.4

FSPECSTD
0
0
0
0

FSPEC_MA
0
0
0
0

FSPECBOD
0
0
0
0

FSPECBRN

0
0
0
0

FSPECBUC

0
0
0
0

FSPECOCU

0
0
0
0

7.1.9 Maximum Value in Data Set

1991
1992
1993
1994

FSPECABN

721
354
710
310

FSPEC_CM

55.0
58.0
66.0
91.18

FSPECSTD

15.6
12.8
28.1
85.77

FSPEC_MA

.
177.0
355.0
155.0

FSPECBOD

3
5
12
3

FSPECBRN

0
25
1
5

FSPECBUC

1
21
0
11

FSPECOCU

2
1
4
1

FSPEC_CM 70.00
FSPECSTD 15.65
FSPECABN 721
FSPECBOD 15
FSPECBUC 7
FSPECBRN 1
FSPECOCU 2
FSPEC_MA 721

7.2 Data Record Example

7.2.1 Column Names for Example Records

STA_NAME	SPECCODE	FSPEC_CM	FSPECSTD	FSPECABN	FSPECBOD
FSPECBRN	FSPECBUC	FSPECOCU	FSPEC_MA	VST_DATE	QA_CODE

7.2.2 Example Data Records

OBS	STA_NAME	SPECCODE	FSPEC_CM	FSPECSTD	FSPECABN	FSPECBOD
1	LA91LR01	ALUTScri	16.95	2.33	2	0
2	LA91LR01	BAIRSANC	15.50	.	1	0
3	LA91LR01	CENTSTRI	13.06	0.35	7	0
4	LA91LR01	DIPLFORM	13.00	.	1	0
5	LA91LR01	DIPLHOLB	11.62	2.47	19	0

OBS	FSPECBRN	FSPECBUC	FSPECOCU	FSPEC_MA	VST_DATE	QA_CODE
1	0	0	0	2	910721	
2	0	0	0	1	910721	
3	0	0	0	7	910721	
4	0	0	0	1	910721	
5	0	0	0	19	910721	

7.3 Related Data Sets

7.3.1 Related Data Set Name

7.3.2 Related Data Set Identification Code

8. GEOGRAPHIC AND SPATIAL INFORMATION

8.1 Minimum Longitude

-97 Degrees 27 Minutes 13.20 Decimal Seconds

8.2 Maximum Longitude

-82 Degrees 39 Minutes 28.20 Decimal Seconds

8.3 Maximum Latitude

30 Degrees 48 Minutes 32.400 Decimal Seconds

8.4 Minimum Latitude

26 Degrees 02 Minutes 55.80 Decimal Seconds

8.5 Name of the area or region

Louisianian Province - Coastal distribution of sampling is along the Gulf of Mexico from the Rio Grande, TX to Anclote Key, FL. States represented: Texas, Louisiana, Alabama, Mississippi, Florida

8.6 Direct Spatial Reference Method

Point

8.7 Horizontal Coordinate System Used

Universal Transverse Mercator

8.8 Resolution of Horizontal Coordinates

0.5

8.9 Units for Horizontal Coordinates

Meters

8.10 Vertical Coordinate System

N/A

8.11 Resolution of Vertical Coordinates

N/A

8.12 Units for Vertical Coordinates

N/A

9. QUALITY CONTROL AND QUALITY ASSURANCE

9.1 Measurement Quality Objectives

Measurement quality objectives were outlined in the Quality Assurance Project Plan. Accuracy and precision goals are outlined

below:

Fish Community Composition	Accuracy Goal	Completeness Goal
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Counting	10 %	90 %
Taxonomic Identification	10 %	90 %
Length Determinations	+ 5 mm	90 %

9.2 Quality Assurance/Control Methods

Data from trawls which did not meet the requirements of a standard trawl were not included in this data file.

Data were run through series of Quality Control examinations:

- 9.2.1 The first method involved manually comparing each field data sheet entry against the electronically stored field data. This form of data validation ensured that data entered onto the field data sheets was correctly and completely transcribed. Occasionally, an error would occur that could not be flagged systematically (ie. Data sheet reflected a length of 11 cm and the electronic data record for the same fish reflected 14 cm. If the length range for this species is 9 cm to 16 cm then neither number is an outlier and a range checking program would not detect the error).
- 9.2.2 Electronic formatted data would also be run through series of programs which would test the validity of the data and provide a flagging mechanism to indicate that further investigation was required:
 - 9.2.2.1 Outlier checks on lengths and range of habitats.
 - 9.2.2.2 Taxonomic identification (e.g. Common name was Hardhead Catfish but Species code indicates a Gafftopsail Catfish).
 - 9.2.2.3 Variable format issues (e.g. Type an alphabetic "0" for a numeric "0").
 - 9.2.2.4 Comparing fish description data (e.g. Taxonomic ids, lengths, etc.) received from labs with the primary EMAP-E fish database. If fish description data varied between the two set of databases the differences were investigated.

9.3 Actual Measurement Quality

N/A

9.4 Sources of Error

9.5 Known Problems with the Data

9.6 Confidence Level/Accuracy Judgement

9.7 Allowable Minimum Values

9.8 Allowable Maximum Values

9.9 QA Reference Data

10. DATA ACCESS

10.1 Data Access Procedures

A Data Request Package can be requested from a contact under Section 10.3. Data can be downloaded from the WWW site.

10.2 Data Access Restrictions

Data can only be accessed from the WWW site.

10.3 Data Access Contact Persons

Dr. J. Kevin Summers
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10.4 Data Set Format

Data can be transmitted in a variety of formats derived from SAS data files when a Data Request Form is submitted.

10.5 Information Concerning Anonymous FTP

Not accessible

10.6 Information Concerning World Wide Web

Data can be downloaded from the WWW.

10.7 EMAP CD-ROM Containing the Data set

Data not available on CD-ROM

11. REFERENCES

11.1 EMAP References

Heitmuller, P. T. and R. Valente. 1991. Environmental Monitoring and Assessment Program EMAP-Estuaries Louisiana Province: 1991 quality assurance project plan. EPA/ERL-GB No. SR-120. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. 1991. Environmental Monitoring and Assessment Program-Near Coastal Louisiana Province: 1991 Monitoring Demonstration. Field Operations Manual. EPA/600/X-91/XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. and J. K. Summers. 1991. Environmental Monitoring and Assessment Program, Near Coastal - Louisiana Province: 1991 Field Reconnaissance Report - East Region. EPA/600/04-91/XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. and J. K. Summers. 1991. Environmental Monitoring and Assessment Program, Near Coastal - Louisiana Province: Field Training Manual - Crew Chiefs. EPA/600/05-91/XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Macauley, J. M. and J. K. Summers. 1991. Environmental Monitoring and Assessment Program, Near Coastal - Louisiana Province: Field Training Manual - Crews. EPA/600/05-91/XXX. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561.

Summers, J. K., J. M. Macauley and P. T. Heitmuller. 1991. Environmental Monitoring and Assessment Program Implementation Plan for Monitoring the Estuarine Waters of the Louisiana Province - 1991 Demonstration. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561. EPA/600/5-91/228.

Summers, J. K., J. M. Macauley, J. M., P. T. Heitmuller, V. D. Engle, A. M. Adams and G. T. Brooks. 1992. Annual Statistical Summary: EMAP-Estuaries Louisiana Province - 1991. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32561. EPA/600/R-93/001.

U. S. EPA. 1995. Environmental Monitoring and Assessment Program (EMAP): Laboratory Methods Manual - Estuaries, Volume 1: Biological and Physical Analyses. United States Environmental Protection Agency, Office of Research and Development, Narragansett, RI. EPA/620/R-95/008.

11.2 Background References

Engle, V. D., J. K. Summers, G. R. Gaston. 1994. A Benthic Index of Environmental Condition of Gulf of Mexico Estuaries. *Estuaries*. 17: 372-384.

Summers, J. Kevin, John F. Paul, Andrew Robertson. 1995. *Monitoring The Ecological Condition Of Estuaries In The United States*. U. S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Gulf Breeze, FL 32651.

12. GLOSSARY AND TABLE OF ACRONYMS

12.1 Acronym used in the Detailed Documentation

12.2 Definition of Acronym

13. PERSONNEL INFORMATION

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