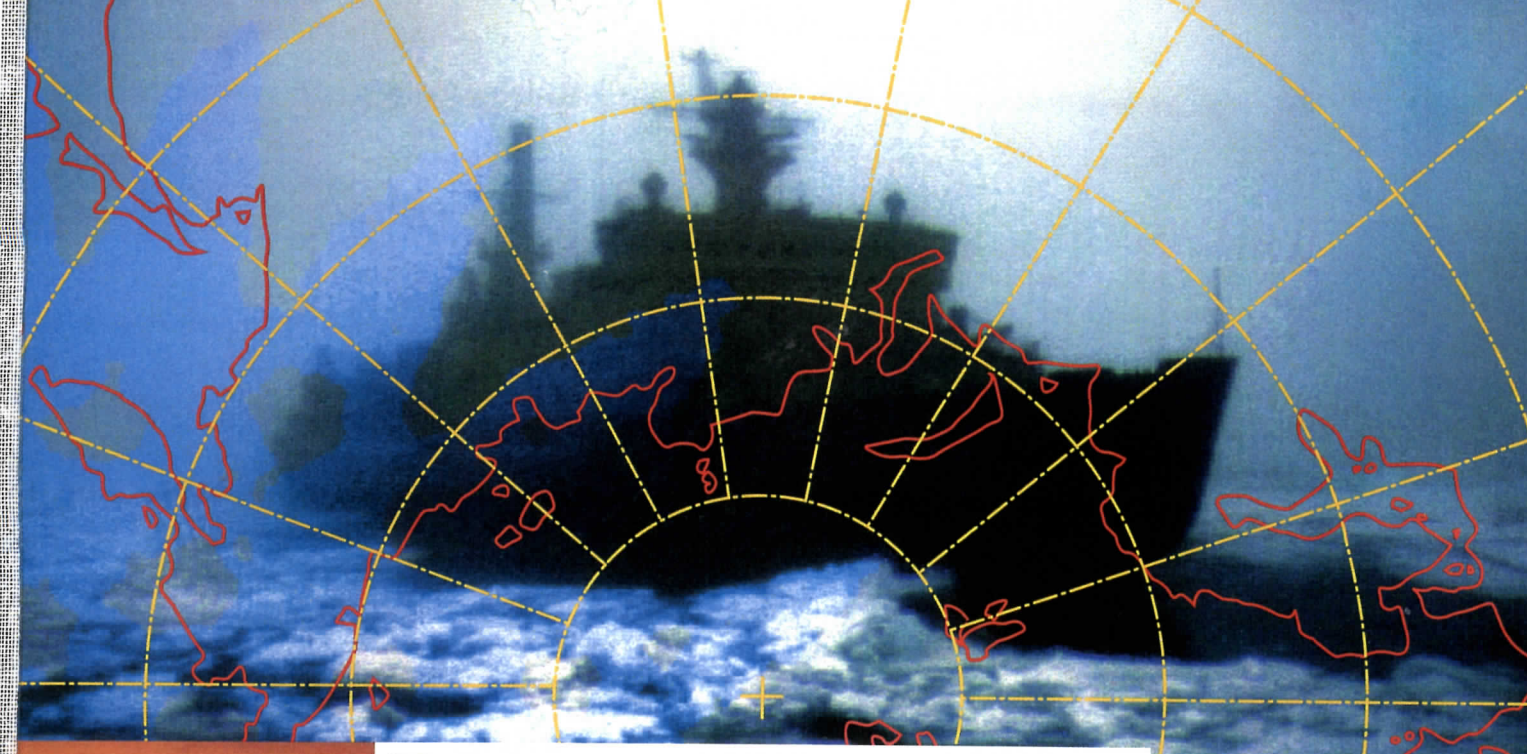
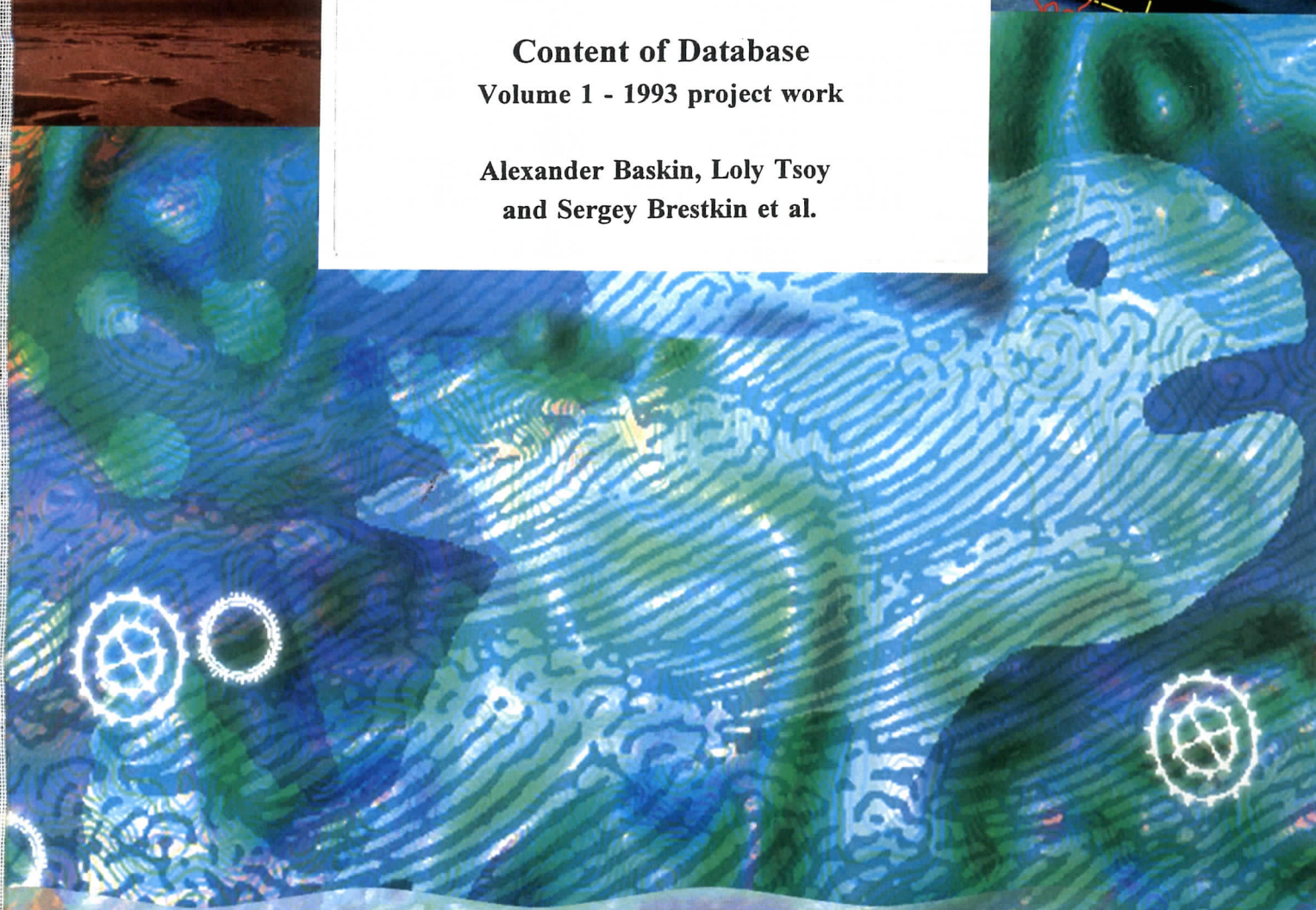


INSROP WORKING PAPER
NO. 26 - 1995, I.4.1

Content of Database

Volume 1 - 1993 project work

Alexander Baskin, Loly Tsoy
and Sergey Brestkin et al.



INSROP International Northern Sea Route Programme

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship and Ocean Foundation, Japan

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia

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Ship & Ocean Foundation, Japan

INSROP WORKING PAPER NO. 26-1995

Sub-programme I: Natural Conditions and Ice Navigation

Project I.4.1: Content of Database.
Volume 1 - 1993 project work.

By: A. Baskin**, L. Tsoy**, V. Vasilyev**, V. Isakov**, Yu. Glebko**, N. Vyssotskaya**, S. Brestkin*, V. Smolyanitsky*, V. Borodachev*, A. Buzuyev*, Yu. Gorbunov*, S. Losev*, V. Abramov*, V. Sokolov*, V. Ivanov*, V. Voyevodin*, S. Frolov*, A. Brovin* and S. Yaroslavtseva*.

Addresses:
*Arctic and Antarctic Research Institute
38 Bering Street
199 397 St. Petersburg
The Russian Federation

** Central Marine Research and Design Institute
Kavalergardskaya Street 6, 193 015 St. Petersburg
The Russian Federation

Date: 11 December 1995.

Reviewed by: Dr. Robert Frederking, National Research Council of Canada.

What is an INSROP Working Paper and how to handle it:

This publication forms part of a Working Paper series from the **International Northern Sea Route Programme - INSROP**. This Working Paper has been evaluated by a reviewer and can be circulated for comments both within and outside the INSROP team, as well as be published in parallel by the researching institution. A Working Paper will in some cases be the final documentation of a technical part of a project, and it can also sometimes be published as part of a more comprehensive INSROP Report. For any comments, please contact the authors of this Working Paper.

FOREWORD - INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are **Central Marine Research & Design Institute (CNIIMF)**, St. Petersburg, Russia; **Ship and Ocean Foundation (SOF)**, Tokyo, Japan; and **Fridtjof Nansen Institute (FNI)**, Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

SPONSORS FOR INSROP

- Nippon Foundation/Ship & Ocean Foundation, Japan
- The government of the Russian Federation
- The Norwegian Research Council
- The Norwegian Ministry of Foreign Affairs
- The Norwegian Ministry of Industry and Energy
- The Norwegian Ministry of the Environment
- State Industry and Regional Development Fund, Norway
- Norsk Hydro
- Norwegian Federation of Shipowners
- Fridtjof Nansen Institute
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- Northern Sea Route Administration, Russia
- Arctic & Antarctic Research Institute, Russia
- ARTEC, Norway
- Norwegian Polar Research Institute
- Norwegian School of Economics and Business Administration
- SINTEF NHL (Foundation for Scientific and Industrial Research - Norwegian Hydrotechnical Laboratory), Norway.

PROGRAMME COORDINATORS

- **Yuri Ivanov, CNIIMF**
  Kavalergardskaya Str.6
  St. Petersburg 193015, Russia
  Tel: 7 812 271 5633
  Fax: 7 812 274 3864
  Telex: 12 14 58 CNIMF SU
- **Willy Østreng, FNI**
  P.O. Box 326
  N-1324 Lysaker, Norway
  Tel: 47 67 53 89 12
  Fax: 47 67 12 50 47
  Telex: 79 965 nanse n
  E-mail: Elin.Dragland @fni.
  wpoffice.telemax.no
- **Masaru Sakuma, SOF**
  Senpaku Shinko Building
  15-16 Toranomon 1-chome
  Minato-ku, Tokyo 105, Japan
  Tel: 81 3 3502 2371
  Fax: 81 3 3502 2033
  Telex: J 23704

PART I:

DATABASE ON TECHNICAL, ECONOMIC AND ICE PROPERTIES OF EXISTING ICE CARGO SHIPS

Project 1.4.1 "Content of database"

Section 1.4.1.1 "Database on technical, economic and ice properties of existing ice cargo ships"

SUMMARY

Prepared is the database on technical, operational and cost characteristics as well as on ice properties of domestic Arctic navigation cargo ships being assigned ice strengthening categories ULA, UL and L1 in the class symbols of the Russian Sea Register.

The comprehensive information on each ship will allow to any potential shipper, freighter, lease holder to find most optimal solutions for the safe and efficient version of the delivery of cargo along the Northern Sea Route.

This database may be used as a part of mathematical models to solve practical problems on the assessment of the efficiency of cargo transportation along the Northern Sea Route depending on the type of transport, ship's parameters and navigational conditions.

The database is arranged in files of the dBASE III PLUS structure.

Sequence of work at data base loading
(availability of free memory on a hard disk 4 MB)

1. Make directory on a hard disk.
2. Copy 10 files from diskette into the directory.
3. Activate package files arje_so.bat and arje_sl.bat.
4. Activate UTILITY dbu.exe.

The customer is given:

- data base archive on ships — sol_7.arj
- reference information archive — slow.arj
- program for the work with archives (compressed files) — arj.exe
- package files for the extraction from archive of files:
  - with information on ships — arje_so.bat, arjso.lst
  - with reference information — arje_sl.bat, arjsl.lst
- UTILITY for work with data base files — dbu.exe, dbu.hlp
- UTILITY for scrolling of DBF structure files — dbview.exe
- List of identifiers and parameters.

Information about ships is collected in the following information blocks:

Block 1 (so1.dbf) - general data on ship (principal dimensions, displacement, power of the propulsion plant etc.);
Block 2 (so2.dbf) - structural data on hull;
Block 3 (so2l.dbf) - information on ice properties;
Block 4 (so3.dbf) - technical characteristics of the propulsion plant;
Block 5 (so4.dbf) - technical and operational data;
Block 6 (so5.dbf) - cargo spaces and cargo handling facilities;
Block 7 (so6.dbf) - convention equipment;
Block 8 (so7.dbf) - other information.

DATA BASE PARAMETERS

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
mns	N 6	1.1. Identif.number of vessel		SO1
rns	C 10	1.2. Number of registry of vessel		SO1
ks	N 6	1.3. Code according to		SO1
asu	C 24	1.4. Name of vessel(Rus.letters)		SO1
lsu	C 24	1.5. Name of vessel(Roman letters)		SO1
bns	C 30	1.6. Former name of vessel und		SO1
ist	N 1	1.7. Original type	SL1	SO1
ost	N 5	Basic type	SL2	SO1
opt	N 3	Basic subtype	SL3	SO1
dgh	N 3	Add.cargo-related character.	SL3	SO1
hgu	N 3	Other charracteristics	SL3	SO1
tgh	N 2	1.8. Vessel vixing of RD MMM	SL5	SO1
pgs	N 1	1.9. Vessel category	SL6	SO1
ksr	N 3	Series or number of project	SL7	SO1
ppp	N 6	1.10.Owner	SL13	SO1
ppp1	N 6	1.11.Former owner	SL13	SO1
por	C 20	1.12.Port of registry		SO1
acc	C 2	1.13.Building country	SL10	SO1
kvr	N 4	1.14.Building yard	FIR	SO1
pro	C 30	1.15.Project index.Designer		SO1
dps	D	1.16.Building data		SO1
dpa	D	1.17.Data where the ves.was		SO1
cls	N 3	1.18.Class of the vessel	SL8	SO1
clr	C 26	Class notation		SO1
slk	C 3	Ice category		SO1
snp	C 1	Subdivision marks		SO1
sav	C 2	Automation marks		SO1
srp	C 4	Marks for areas of navigation		SO1
rgw	C 6	1.20.Gross tonnage,r.t		SO1
rgn	C 6	1.21.Net tonnage,r.t		SO1
nrtp	C 6	1.22.Net Panama Canal tonnage		SO1
nrts	C 6	1.23.Net Suez Canal tonnage		SO1
dpz	C 6	1.24.Deadweight,t		SO1
flg	C 2	1.25.Flag ofthe vessel	SL10	SO1
pzr	C 4	1.26.Call letters		SO1
nis	C 7	1.27.INMARSAT number		SO1
pds	N 1	1.28.Cause of writing-off	SL15	SO1
dsp	D	Date of writting-off		SO1
pr11	C 50	1.29.Note		SO1
pr12	C 75	----"----		SO1
pr13	C 75	----"----		SO1

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
lmx	C 6	2.1. Overall length,m		SO2
lpe	C 6	2.2. Designed length,m		SO2
bmx	C 5	2.3. Extreme breadth,m		SO2
hbo	C 5	2.4. Depth,m		SO2
hsu	C 6	2.5. Air draft,m		SO2
olm	C 5	2.6. Summer draft,m		SO2
mat	C 30	2.7. Hull material		SO2
syn	C 30	2.8. Framing system		SO2
kpa	C 1	2.9. Number of decks		SO2
kpp	C 2	2.10.Number of transverse		SO2
kpl	C 1	2.11.Numb.of longitudinal		SO2
sgk	C 9	2.12.1.B.S.Pl.thickness:Plate keel		SO2
sdn	C 9	2.12.2.Thickness,mm:Bottom		SO2
sgw	C 9	2.12.3.Thickness,mm:In way of		SO2
swg	C 9	2.12.4.Thickness,mm:Above LWL		SO2
shg	C 9	2.12.5.Òhickness,mm:Below LWL		SO2
sps	C 9	2.12.6.Thickness,mm:Deck stringer		SO2
ssi	C 9	2.12.7.Thickness,mm:Shirstreck		SO2
dnwp	C 4	2.13.1.Adm.loads on upper deck		SO2
dnwz	C 4	Adm.loads on hatch covers		SO2
dn1p	C 4	2.13.2.Adm.loads on deck No.1		SO2
dn1z	C 4	Adm.loads on hatch covers		SO2
dn2p	C 4	2.13.3.Adm.loads on deck No.2		SO2
dn2z	C 4	Adm.loads on hatch covers		SO2
dndd	C 4	2.13.4.Adm.loads on tank top		SO2
gfu	C 6	2.14.Displacement at summer		SO2
gpo	C 6	2.15.Light displacement,t		SO2
g1s	C 4	2.16.Displacement per 1ñì of draft		SO2
odn	C 4	2.17.Docking draft,m: - forward		SO2
odk	C 4	Docking draft,m: - aft		SO2
dom	C 5	2.18.Mass for docking,t		SO2
dob	C 5	2.19.Amount of ballast for docking		SO2
opn	C 4	2.20.Light draft,m: - forward		SO2
opk	C 4	Light draft,m: - aft		SO2
okk	C 30	2.21.Hull design features		SO2
usk	C 40	Stabilizers		SO2
ftg	C 4	2.22.Pull at the hook ,êN		SO2
kaz	C 4	2.23.Chain cable diameters,mm		SO2
ktz	C 1	Chain cable grade		SO2
snb	C 5	Equipment number		SO2
pr21	C 50	2.24.Note		SO2
pr22	C 75	-----"-----		SO2
pr23	C 75	----"----		SO2
lkwl	C 6	2l.1 Length on DLW,m		SO2L
bkwl	C 5	2l.2 Breadth on DLW,m		SO2L
oar	C 5	2l.3 Draft,arctic water,m		SO2L
gar	C 6	2l.4 Displacement at arctic draft,t		SO2L
dar	C 6	2l.5 DWT at arctic draft,t		SO2L
nar	C 6	2l.6 Load carrying cap.at arct.draft		SO2L
pwo	C 5	2l.7 Shaft power,total,kW		SO2L
rpw	C 7	Power distribution on shafts		SO2L
tgws	C 4	2l.8 Propeller thrust,centre		SO2L
tgwb	C 4	2l.8 Propeller thrust,side		SO2L
tgwo	C 4	2l.8 Propeller thrust,total		SO2L
dgwo	C 4	2l.9 Propeller diameter,m		SO2L
unf	C 3	2l.10 Bow rake,deg		SO2L
uns	C 3	2l.11 Entrance angle of DLW,deg		SO2L
ur0	C 3	2l.12 Flare angle of frame No.0,deg.		SO2L

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
nbm	C 3	2I.13 Side slope at midships,deg.		SO2L
kop	C 3	2I.14 Block coefficient		SO2L
urnp	C 3	2I.15 Section flare angle at F.P,deg		SO2L
ur2t	C 3	Section flare angle at sec.No.2		SO2L
urms	C 3	Section flare angle at midships		SO2L
eps	C 3	2I.16 Service period,days		SO2L
rtl	C 4	2I.17 Fuel consumption, kg/kw.hr		SO2L
wtl	C 12	2I.18 Kind of fuel		SO2L
tsu	N 1	3.1. Type of prop.plat	SL9	SO3
kis	C 1	3.2. Number of M.E.1		SO3
pdk	C 5	Power of M.E.1,kW		SO3
kis1	C 1	Number of M.E.2		SO3
pdk1	C 5	Power of M.E.2 kW		SO3
dio1	C 4	3.3. Building year of M.E.1		SO3
dio2	C 4	Building year of M.E.2		SO3
cdi	C 2	3.4. Country where M.E.were built	SL10	SO3
kfi	N 4	3.5. M.E.manufacturer	FIR	SO3
kiz1	N 11	3.6. M.E.1 make	SL12	SO3
kiz2	N 11	M.E.2 make	SL12	SO3
kgk	C 1	3.7. Number of main boilers		SO3
tgk	C 60	Type of main boilers		SO3
dgk	C 4	3.8. Pressure of main boilers,mPa		SO3
pnk	C 4	Heating surface of m.boil.sq.m		SO3
kwk	C 1	3.9. Number of auxiliary boilers		SO3
twk	C 60	Type of auxiliary boilers		SO3
kgd1	C 1	3.10.Number of propulsion motors		SO3
mgd1	C 5	Power of propulsion motors		SO3
kgd2	C 1	Number of propulsion motors 2		SO3
mgd2	C 5	Power of propulsion motors		SO3
kge1	C 1	3.14.Number of aux. generators 1		SO3
mge1	C 5	Power of aux.generators 1,kW		SO3
kge2	C 1	Number of aux.generators 2		SO3
mge2	C 5	Power of aux.generators 2,kW		SO3
kge3	C 1	Number of aux.generators 3		SO3
mge3	C 5	Power of aux.generators 3,kW		SO3
kde1	C 1	3.11.Number of aux.engines 1		SO3
mde1	C 5	Power of aux.engines 1,kW		SO3
kde2	C 1	Number f aux.engines 2		SO3
mde2	C 5	Power of aux.engines 2,kW		SO3
kde3	C 1	Number of auxiliary engines 3		SO3
mde3	C 5	Power of auxiliary engines 3		SO3
cwd	C 2	3.12.Country of manufact.of	SL10	SO3
fwd	N 4	Manufacturer of aux.engines	FIR	SO3
mwd	N 11	3.13.Make of auxiliary engines 1	SL12	SO3
twd	C 3	Type of auxiliary engines 1		SO3
mwd2	N 11	Make of auxiliary engines 2	SL12	SO3
twd2	C 3	Type of auxiliary engines 2		SO3
tdg	C 36	3.15.Propeller type		SO3
kgw	C 1	3.16.Number of propeller		SO3
klp	C 1	Number of blades on a propeller		SO3
fws	C 3	3.17.Propeller RPM centre		SO3
fwb	C 3	Propeller RPM side		SO3
lgw	C 6	3.18.Propeller shaft length,m		SO3
kpu	C 1	3.19.Number of thrusters		SO3
rpu	C 30	Location and capacity of thrusters		SO3
rmo	C 20	3.20.Arrangement of engine room		SO3
pr31	C50	3.21.Note		SO3
pr32	C 75	—"—		SO3
pr33	C 75	—"—		SO3

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
net	C 6	4.1. Net capacity,t		SO4
gls	C 6	4.2. Timber capacity,t		SO4
ogs	C 5	4.3. Load draft,m		SO4
oss	C 5	4.4. Specification draft,m		SO4
gsp	C 6	4.5. Net capacity specification,t		SO4
kbt	C 2	4.6. Number of ballast tanks		SO4
gbt	C 6	Capacity of all ballast tanks,cu.m		SO4
pas	C 4	4.7. Number of borthed passengers		SO4
psb	C 4	Number of unborthed		SO4
kom	C 3	4.8. Crew size		SO4
kzm	C 2	4.9. Number of space places		SO4
vgr	C 4	4.10.Speed loaded		SO4
vbl	C 4	Speed in ballast		SO4
ztd	C 6	4.11.D.O. capacity,t		SO4
top	C 18	Grade of recommended D.O.		SO4
ztt	C 6	4.12.H.O. capacity,t		SO4
tod	C 18	Grade of recomended H.O.		SO4
avp	C 3	4.13.Stores-based endurancy		SO4
ozm	C 4	4.14.L.O. capacity,t		SO4
zwp	C 4	4.15.Drinking water capacity,t		SO4
zws	C 4	4.16.Washing water capacity,t		SO4
zwt	C 4	4.17.Boiler water capacity,t		SO4
rtx	C 5	4.18.Daily fuel consumption at sea,t		SO4
rts	C 5	4.19.Dailyfuel consumption in port		SO4
rwp	C 4	4.20.Daily drinking water		SO4
rws	C 5	4.21.Daily washing water		SO4
rwx	C 5	4.22.Daily boiler water cons.at sea		SO4
rwt	C 5	4.23.Daily boiler water cons.in port		SO4
pdg	C 12	Heaters		SO4
dals	C 5	4.25.Operating range,n.mil,specif.		SO4
dalm	C 5	Operating range.m.mil,maximum		SO4
lu1	C 40	4.26.Ice passability		SO4
pr41	C 50	4.27.Note :		SO4
pr42	C 75	——"——		SO4
pr43	C 75	——"——		SO4
kb1	C 5	Cubic capacity of hold No.1,cu.m		SO5
gl1	C 4	Depth of hold No.1,m		SO5
kb2	C 5	Cubic capacity of hold No.2,cu.m		SO5
gl2	C 4	Depth of hold No.2,m		SO5
kb3	C 5	Cubic capacity of hold No.3,cu.m		SO5
gl3	C 4	Depth of hold No 3,m		SO5
kb4	C 5	Cubic capacity of hold No.4,cu.m		SO5
gl4	C 4	Depth of hold No 4,m		SO5
kb5	C 5	Cubic capacity of hold No.5,cu.m		SO5
gl5	C 4	Depth of hold No.5,m		SO5
kb6	C 5	Cubic capacity of hold No.6.cu.m		SO5
gl6	C 4	Depth of hold No.6,m		SO5
kb7	C 5	Cubic capacity of hold No.7,cu.m		SO5
gl7	C 4	Depth of hold No.7,m		SO5
kb8	C 5	Cubic capacity of hold No.8,cu.m		SO5
gl8	C 4	Depth of hold No.8,m		SO5
kb9	C 5	Cubic capacity of hold No.9,cu.m		SO5
gl9	C 4	Depth of hold No.8,m		SO5
kb10	C 5	Cubic capacity of hold No.10cu.m		SO5
gl10	C 4	Depth of hold No.10,m		SO5
kxt	C 1	5.2. Number of cold-storage holds		SO5
oxt	C 5	Cub.capacity of cold-storage holds		SO5
sxu	C 20	5.3.Class notation of ref.plant.		SO5

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
ttr	C 4	5.4.Specificat.temperat.of g.-st.h.		SO5
txa	C 16	5.5. Refrigerant types		SO5
wmt1	C 6	5.6 Capacity of hold,cu.m {Ro/Ro)		SO5
wis1	C 3	Clear height of hold,m		SO5
wmt2	C 6	Capacity of lower 'tweendecks		SO5
wis2	C 3	Clear height of lower 'tweedecks		SO5
wmt3	C 6	Capacity of middle 'tweendecks		SO5
wis3	C 3	Clear height of middle 'tweend.		SO5
wmt4	C 6	Capacity of upper 'tweendecks		SO5
wis4	C 3	Clear height of upper 'tweedecks		SO5
plo1	C 6	Usable area of double bottoms		SO5
plo2	C 6	Usable area of lower decks		SO5
plo3	C 6	Usable area of main decks		SO5
plo4	C 6	Usable area of middle decks		SO5
plo5	C 6	Usable area of upper decks		SO5
plo6	C 6	Usable area of truck platforms		SO5
kgt	C 2	5.7. Number of cargo tanks		SO5
ogt	C 6	Cubic capacity of cargo tanks		SO5
gwn	C 6	5.8. Grain capacity,total,cu.m		SO5
gwk	C 6	5.9. Ball capacity,total,cu.m		SO5
kok	C 12	5.10.Number of containers		SO5
krk	C 3	Number of ref.containers		SO5
gta	C 6	5.11.Ro/Ro cargo capacity		SO5
gtl	C 7	5.12.Cargo capacity for sh.barges		SO5
gw1	C 6	5.13.C.capacity of 'tw.in hold no.1		SO5
hw1	C 4	Depth of 'tweendecks in h.no.1		SO5
gw2	C 6	C.capacity of 'tw.in hold no.2		SO5
hw2	C 4	Depth of 'tweendecks in h.no.2		SO5
gw3	C 6	C.capacity of 'tw.in hold no.3		SO5
hw3	C 4	Depth of 'tweendecks in h.no.3		SO5
gw4	C 6	C.capacity of 'tw.in hold no.4		SO5
hw4	C 4	Depth of 'tweendecks in h.no.4		SO5
gw5	C 6	C.capacity of 'tw.in hold no.5		SO5
hw5	C 4	Depth of 'tweendecks in h.no.5		SO5
gw6	C 6	C.capacity of 'tw.in hold no.6		SO5
hw6	C 4	Depth of 'tweendecks in h.no.6		SO5
gw7	C 6	C.capacity of 'tw.in hold no.7		SO5
hw7	C 4	Depth of 'tweendecks in h.no.7		SO5
gw8	C 6	C.capacity of 'tw.in hold no.8		SO5
hw8	C 4	Depth of 'tweendecks in h.no.8		SO5
gw9	C 6	C.capacity of 'tw.in hold no.9		SO5
hw9	C 4	Depth of 'tweendecks in h.no.9		SO5
gw10	C 6	C.capacity of 'tw.in hold no.10		SO5
hw10	C 4	Depth of 'tweendecks in h.no.10		SO5
lk1	C 25	5.14.Numb.and dimens.of c.hatch.in		SO5
lk2	C 25	Numb.and dimens.of c.hatch.in 2		SO5
lk3	C 25	Numb.and dimens.of c.hatch.in 3		SO5
lk4	C 25	Numb.and dimens.of c.hatch.in 4		SO5
lk5	C 25	Numb.and dimens.of c.hatch.in 5		SO5
lk6	C 25	Numb.and dimens.of c.hatch.in 6		SO5
lk7	C 25	Numb.and dimens.of c.hatch.in 7		SO5
lk8	C 25	Numb.and dimens.of c.hatch.in 8		SO5
lk9	C 25	Numb.and dimens.of c.hatch.in 9		SO5
lk10	C 25	Numb.and dimens.of		SO5
gus1	C 20	5.15 Numb,l.cap.derrick and		SO5
gus2	C 20	Numb.l.cap.derrick and crane,2h		SO5
gus3	C 20	Numb.l.cap.derrick and crane,3h		SO5
gus4	C 20	Numb.l.cap.derrick and crane,4h		SO5
gus5	C 20	Numb.l.cap.derrick and crane,5h		SO5

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
upw	C 20	5.16.Ro/Ro cargo handling gear		SO5
drm	C 4	Ramp length,m		SO5
srm	C 4	Ramp width,m		SO5
gns	C 20	5.17.Cargo pump types		SO5
pns	C 4	Cargo pump capacity,cu.m/hr.		SO5
dog	C 24	5.18.Dangerous cargo permit.for		SO5
pr51	C 50	5.19.Note		SO5
pr52	C 75	----"----		SO5
pr53	C 75	----"----		SO5
swt1	C 1	6.1.1.Water fire main s.in eng.room		SO6
swt2	C 1	Water fire main s.in cargo spaces		SO6
swt3	C 1	Water fire main s.in accommodation		SO6
ssp1	C 1	6.1.2.Sprinkler syst.in engine room		SO6
ssp2	C 1	Sprinkler system in cargo spaces		SO6
ssp3	C 1	Sprinkler system in accommodation		SO6
suk1	C 1	6.1.3.CO2 smothering s.in engine r.		SO6
suk2	C 1	CO2 smothering syst.in cargo		SO6
suk3	C 1	CO2 smothering syst.in		SO6
stx1	C 1	6.1.4.Halogen.Hydrocarbon s.in		SO6
stx2	C 1	Halogen.Hydrocarbon s.in cargo		SO6
stx3	C 1	Halogen Hydrocarbon s.in		SO6
spn1	C 1	6.1.5.Foam fire extinguish.in eng.r.		SO6
spn2	C 1	Foam fire extinguishing s.in carg.s.		SO6
spn3	C 1	Foam fire extinguishing s.in		SO6
spt1	C 1	6.1.6.Dry powder system in		SO6
spt2	C 1	Dry powder system in cargo room		SO6
spt3	C 1	Dry pwder systems in		SO6
sig1	C 1	6.1.7.Inert gas system in engine r.		SO6
sig2	C 1	Inert gas system in cargo spaces		SO6
sig3	C 1	Inert gas system in accommodation		SO6
r61	C 16	6.1.8.Reserve system		SO6
r611	C 24	Employment of reserve systems		SO6
kss	C 2	6.2.1.Number of lifeboats No.1		SO6
wms	C 3	Carrying capacity of lifeboats 1		SO6
tss	C 20	Type,hull material of lifeboats 1		SO6
kss1	C 2	Number of lifeboats No.2		SO6
wms1	C 3	Carrying capacity of lifeboats 2		SO6
tss1	C 20	Type,hull material of lifeboats 2		SO6
kss2	C 2	Number of liftboats No.3		SO6
wms2	C 3	Carrying capacity of lifeboats 3		SO6
tss2	C 20	Type,hull material of lifeboats.3		SO6
kss3	C 2	Number of lifeboats No.4		SO6
wms3	C 3	Carrying capacity of lifeboats 4		SO6
tss3	C 20	Type,hull material of lifeboats 4		SO6
ksp	C 3	6.2.2.Number of liferafts No.1		SO6
wmp	C 3	Carrying capacity of liferafts 1		SO6
tsp	C 20	Type of liferafts 1		SO6
ksp1	C 16	Number of liferafts No.2		SO6
wmp1	C 16	Carrying capacity of liferafts 2		SO6
tsp1	C 16	Type of liferafts 2		SO6
ns1	C 16	6.3.1.Magnetic Compass		SO6
ns2	C 16	6.3.2.Gyrocompass		SO6
ns3	C 16	6.3.3.Radar		SO6
ns4	C 16	6.3.4.Echo-Sounder		SO6
ns5	C 16	6.3.5.Lag		SO6
ns6	C 16	6.3.6.Autopilot		SO6
ns7	C 16	6.3.7.Direction-Sinder		SO6
ns8	C 16	6.3.8.ARPA		SO6
ns9	C 16	6.3.9.Radionavigation syst.receiver		SO6

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
ns10	C 16	6.3.10.Satellite ship carth station		SO6
ns11	C 16	6.3.11.Automatic navigational		SO6
ns12	C 16	6.3.12.Ship turning rate meteor		SO6
ns13	C 16	6.3.13.Reserve		SO6
ra1	C 16	6.4A.1.Radiotelegraph station		SO6
ra2	C 16	6.4A.2.Operation. radiotelegraph st.		SO6
ra3	C 16	6.4A.3.Radiotelephone station		SO6
ra4	C 16	6.4A.4.Radiotelegraph/telephone st.		SO6
ra5	C 16	6.4A.5.Operational radiotelephone st		SO6
ra6	C 16	6.4A.6.VHF radiotelephone station		SO6
ra7	C 16	6.4A.7.Radio stat.for survival craft		SO6
ra8	C 16	6.4A.8.Aut.distress transmitter/rec.		SO6
ra9	C 16	6.4A.9.NAVTEX receivers		SO6
ra10	C 16	6.4A.10.Satellite EPRRB		SO6
ra11	C 30	6.4A.11.Reserve 1		SO6
ra12	C 30	6.4A.12.Reserve 2		SO6
rb1	C 16	6.4Á.1.VHF radio (as a set)		SO6
rb2	C 16	6.4Á.2.MF radio (as a set)		SO6
rb3	C 16	6.4Á.3.MF/HF radio (as a set)		SO6
rb4	C 16	6.4Á.4.Aut.radiotel.alarm transmit.		SO6
rb5	C 16	6.4Á.5.NAVTEX receiver		SO6
rb6	C 16	6.4Á.6.EGC receiver		SO6
rb7	C 16	6.4Á.7.HF Radiotelex(NBDP)		SO6
rb8	C 16	6.4Á.8.COSPAS-SARSAT EPRB		SO6
rb9	C 16	6.4Á.9.INMARSAT EPRB		SO6
rb10	C 16	6.4Á.10.Radar transponder		SO6
rb11	C 16	6.4Á.11.2182kHz watchkeeping		SO6
rb12	C 16	2182kHz automatic alarm receiv.		SO6
rb13	C 16	6.4Á.12.Command broadcast		SO6
rb14	C 16	6.4Á.13.Reserve		SO6
ktn	C 2	6.5.1.Tanks(slope,storage) number		SO6
ttn	C 8	Tanks(slope,storage) type		SO6
kib	C 2	6.5.2.Number of segregated		SO6
wib	C 6	Total capacity of segregated bal.tn.		SO6
smt	C 3	6.5.3.Provis.of crude oil tank wash.		SO6
sfo	C 35	6.5.4.Separating or filter.equipment		SO6
sas	C 3	6.5.5.Eng.room bilge w.discharge		SO6
pog	C 3	6.6.6.Bal.and washing w.control		SO6
spw	C 3	6.7.7.Oily water transfer,disposal s		SO6
r65	C 20	6.8.8.Reserve		SO6
uos	C 20	6.6.1.Sewage pollution prevention f.		SO6
uis	C 3	6.6.2.Sewage		SO6
sbn	C 3	6.6.3.Provision of holding tanks		SO6
r66	C 20	6.6.4.Reserve		SO6
usm	C 15	6.7.1.Garbage pol.prevent.facilities		SO6
uom	C 4	6.7.2.Garbage burning plant(incin.)		SO6
usb	C 15	6.7.3.Garbage collecting equipment		SO6
r67	C 20	6.7.4.Reserve		SO6
cap	C 30	7.1.Master (Surname,F.n.,P.)		SO7
ded	C 30	7.2.Chief Engineer(Surname,F.n.,P.)		SO7
ppr	N 1	7.3.Arrival (reception) form	SL16	SO7
tlx	C 6	7.4.Telex number		SO7
cnc	C 6	7.5.Hull num.of the ves.when b.built		SO7
pfw	N 1	7.6.Form of ownership		SO7
spo	C 8	7.7.Building cost ,m.rbls.		SO7
spbr	C 8	Book cost,m.rbls		SO7
dsbr	D	Date of entry of book cost		SO7
spbd	C 8	Book cost,m rbls		SO7
nss	C 2	7.8.Set service life		SO7

IDEN-TIFIER	FORMAT (N - num., C - sys., D - date)	PARAMETER NAME	GLOSSARY FILE NAME	FILE NAMES
r76	C 40	7.9.Reserve		SO7
dosw	D			SO7
mos	C 48			SO7
wio	C 48			SO7
ro1	C 60			SO7
ro2	C 60			SO7
ro3	C 60			SO7
ro4	C 60			SO7
ro5	C 60			SO7
ro6	C 60			SO7
slo	D			SO7
dop	D			SO7
tr1	C 70			SO7
tr2	C 70			SO7
tr3	C 70			SO7
vrf	C 32			SO7
lng	C 3			SO7
dip	D			SO7
obf	C 8			SO7
obd	C 8			SO7

PART II:

DEVELOPMENT OF THE BASE OF CARTOGRAPHY DATA IN THE FORM OF ELECTRONIC CATALOGUE OF CHARTS

I.4.1.2 "Development of the base of cartography data in the form of electronic catalogue of charts"

Key personnel:

Doct. V.Vasilyev, researcher, CNIIMF
Dipl.eng. V.Isakov, hydrographer, CNIIMF

Summary

The study of existing traditional and electronic maps on NSR was executed. The first versions of electronic maps catalogue were compiled and the most suitable form was chosen. The concept and structure of electronic catalogue was worked out.

Keywords : database, charts catalogue, electronic cartography, coordinates system.

"Development of the base of cartography data in the form of electronic catalogue of charts"

The main aim of the work on this project is to propose a form and to create a demo version of an electronic catalogue of charts to be used on the NSR. We consider that the catalogue should be run on PC compatible computers using MS-DOS with 2 MB RAM, hard disk, and VGA or SVGA display, colour or monochrome.

Analysing the existing databases, such as dBase, Oracle, Clarion, so on, running under MS-DOS, we came to the conclusion, that Paradox by Borland Inc. is the most suitable for electronic chart catalogue. Paradox is the most powerful database with friendly interface. Also, it is possible to compile catalogue as a stand-alone executable program using Borland C++ compiler within Paradox Engine utilities. So we used .dB type files of Paradox 4.0 and recommend them to be used in cartography databases.

Our main idea was to create a database containing enough information for the navigator to chose charts, needed for his sailing. One of the proposed structures is shown in table 1.

STRUCT	Field Name	Field Type
1	Ad_numb	A8
2	Lat_b	A10
3	Lon_b	A10
4	Lat_e	A10
5	Lon_e	A10
6	Scale	A11
7	Date_corr	A8
8	Numb_corr	A4
9	Lat_base	A10
10	Depth	A2
11	Name	A120
12	Lat_delta	A10
13	Lon_delta	A10

As can be seen, all thirteen fields are of alphanumeric type. Paradox provides the following types of fields: alphanumeric (A_), numeric (N_), currency amounts ($), date (D).

First field, "Ad_numb" contains the data on the publisher issue number.
Second field, "Lat_b" contains the latitude of the lower left corner of the chart.
Third field, "Lon_b" contains the longitude of the lower left corner of the chart.
Forth field, "Lat_e" contains the latitude of the upper right corner of the chart.
Fifth field, "Lon_e" contains the longitude of the upper right corner of the chart.
Sixth field, "Scale" indicates the chart scale.
Seventh field, "Date_corr" contains the date of the last chart updating.
Eighth field, "Numb_corr" contains the number of updates on that chart.
Nineth field, "Lat_base" contains the base latitude for that chart.
Tenth field, "Depth" contains the unit of depth measure.
The biggest eleventh field, "Name" contains the description of the chart geographic position.
Twelveth field, "Lat_delta" contains the delta to be added to the latitude in the chart to be corrected to standart value, e.g. WGS-84.
Thtirteens field "Lon_delta" contains the delta to be added to the lontitude in the chart to be corrected to standart value.

Here is an example of one record in the table below.

Paradox View

Ad_numb	697
Lat_b	72°50.00N
Lon_b	56°00.00E
Lat_e	77°30.00N
Lon_e	81°00.00E
Scale	1:700000
Date_corr	27/12/92
Nmb_corr	50
Lat_base	75°00.00N
Depth	
Name	ARCTIC OCEAN.KARA SEA
From	NOVAYA ZEMLYA to DIKSON
Lt_delta	0.0N
Ln_delta	0.0E

The described form was proposed by the Transas Marine software house and is used by Transas Marine in its software. It was worked out for the international user and so is suitable for INSROP purposes. It is freeware worked out especially for use in electronic chartography. The structure allows to use the catalogue for storing data on former USSR, Great Britain Admiralty, Australian and other publishers charts.

Here is another structure proposed by CNIIMF for its own purposes and used sucsessfully.

1	Адмиралтейский #	N
2	Признак	A3
3	Гриф	A1
4	Знаменатель масштаба	A10
5	Координата 1	A10
6	Координата 2	A10
7	Координата 3	A10
8	Координата 4	A10
9	Дата корректуры	D
10	Поправка широты	A6
11	Поправка долготы	A6
12	Наименование карты	A120
13	Год издания	N
14	Система координат	A1
15	Примечание	A30

Here is an example of a record on the same chart #697 of the Russian Navy catalogue in table by CNIIMF.

1	Адмиралтейский #	687
2	Признак	
3	Гриф	
4	Знаменатель масштаба	700 000
5	Координата 1	72 50 N
6	Координата 2	77 30 N
7	Координата 3	56 00 E
8	Координата 4	81 00 E
9	Дата корректуры	6/15/91
10	Поправка широты	0
11	Поправка долготы	0
12	Наименование карты	Наименование карты:Карское море от Новой Земли до о.Диксон
13	Год издания	1991
14	Система координат	K
15	Примечание	

A script running under Paradox for easy transfer from CNIIMF base to Transas Marine base is shown below.

Query

```
Catalog | Адмиралтейский # | Признак | Знаменатель масштаба |
        |_1              |_2     |_4               |
        |                |       |                 |
        |                |       |                 |

 Catalog | Координата 1  | Координата 2 |      Координата 3
|
        | _5, not blank | _6, not blank | _7, not blank, not "E"
|
        |               |               |
|
        |               |               |
|

 Catalog | Координата 4  | Дата корректуры | Поправка широты |
Поправка долготы |
        | _8, not blank | _9              | _10             |
_11             |
        |               |                 |                 |
          |
        |               |                 |                 |
          |

 Catalog | Наименование карты |
        | _12               |
        |                   |
        |                   |

  G1   | Ad_numb | Lat_b | Lon_b | Lat_e | Lon_e |  Scale  |
Date_corr |
 insert | _1+_2  | _5   | _7   | _6   | _8   | "1:"+_4 | _9
    |
      |      |    |    |    |    |      |
    |
      |      |    |    |    |    |      |
    |

  G1   | Name | Lat_delta | Lon_delta |
        | _12 | _10      | _11       |
        |     |          |           |
        |     |          |           |
```

Endquery
Do_it!

The main work of creating the database was fulfilled. The database contains more than 600 charts on the NSR. Some of them are open for international use. We now have the data on the charts to be open in the nearest future. As soon as they would be open we shall enter the data on them in the catalogue. One of the tasks of future work would be to have all the time updated to the last changes catalogue. The database file (or updating file with additions) can be easily transmitted via electronic mail within every important update.

The diskette with electronic catalogue and example is amended. The instructions for operation are in the readme.doc file.

PART III:

DESCRIPTION OF THE EXISTING DATABASE OF NAVIGATIONAL ROUTES AND ENVIRONMENTAL CONDITIONS THERE, BY DIFFERENT AREAS OF THE NSR IN DIFFERENT SEASONS

KEY PERSONNEL:

1 - V. Smolyanitsky, AARI

2 - V. Borodachev, AARI

3 - A. Buzuyev, S. Brestkin, AARI

4 - Yu. Gorbunov, S. Losev, S. Brestkin, AARI

5 - Yu. Gorbunov, S. Losev, AARI

6 - S. Losev, AARI

7 - Yu. Gorbunov, S.Losev, AARI

8 - V. Abramov, AARI

9 - V. Sokolov, AARI

10 - V. Ivanov, V.Voyevodin, AARI

11 - S. Frolov, A. Buzuyev, A. Brovin, AARI

12 - S. Brestkin. S. Yaroslavtseva, AARI

SUMMARY

The contents of the database on the environmental characteristics, which can be used in the interest of INSROP (for the justification of possible international shipping along the NSR, organization of planning and operational support, a retrospective analysis of the effectiveness and safety of transit navigation in various seasons, modelling of ship motion in the ice) have been identified on a preliminary basis. The volume, quality and organization level of the data available at the AARI are assessed, the initial data, data sets on technical media, databases of a different degree of completeness are described. General requirements to the structure and software of the databases, created in the framework of INSROP are formulated.

The results of the activities to set up the World Data Center "Sea-Ice" (WDC-B), as well as to create databases on a wide range of characteristics, databases on ice and meteorological conditions on standard and optimal navigation routes along the NSR, carried out at the AARI, are described. The prospects for the development of specialized databases are assessed.

TABLE OF CONTENTS

INTRODUCTION

The Project goal is to set up the databases on natural conditions at different parts of transit navigation along the NSR, for the following purposes:

justification of the possibility and the prospects of international shipping along the NSR;
a retrospective analysis of the effectiveness and safety of shipping in different seasons;
modelling of ship motion in ice.

It is planned that the databases will be incorporated into the information system by a distributive type. And the databases, containing the primary information will remain at those institutions where they were created. In the course of the fulfilment and implementation of the INSROP program the specialists of these institutions will maintain, supplement, develop and use the databases to meet the requests, prepare reference materials and recommendations. The databases with a generalized specialized information and the information on the contents of the initial databases will be reported to the NSR management bodies.

The objectives of the first stage include:

a preliminary definition of the content of the databases by elements (environmental characteristics);

estimation of the volume, quality and organization level of the avai lable AARI data, which can be used in the interest of INSROP. The Report contains a brief description of the available data archived at the AARI, data sets on technical media, databases of different completeness. The last section formulates general requirements to the structure and software of the databases, created within the framework of the INSROP.

1 GLOBAL DIGITAL SEA ICE DATA BANK

Within the framework of the WMO Project "Global Digital Sea Ice Data Bank" the AARI carries out the work on the establishment of the World Data Center "Sea Ice" (WDC-B) and the international data exchange with the WDC-A for Glaciology of the USA.The data set which is being created includes the data on total and partial ice concentration of different age gradations in accordance with the International Sea-Ice Nomenclature. The data have a space interval of not more than 15x15 nautical miles, covering the period from January 1972 to December 1991 and together with the derivatives and generalized characteristics obtained from them, form the database of the Global Data Bank (GDB) of the AARI.

For the storage of digital information the following formats are used:

national KONTUR format (vector);
SIGRID format for international sea ice data ex change (data storage in the geographical grid points) /1/;
GRID format for data storage in the points of a rectangular grid area;
a hierarchy data storage format HDF.

Basing on the compact form and accuracy of the data presentation in different formats, as well as on the suitability of generalizations, the KONTUR and SIGRID formats are chosen for the non-operational storage of the actual data in the GDB of the AARI, the GRID format - for the intermediate data storage, the HDF format - for the formation of the climatic databases.

The technology to supplement the databases, process and obtain climatic data includes:

digitizing of archived data on paper media with the reduction to the KONTUR format and their input into the non-operational vector database;
data conversion from the vector format to the raster equidistant one and then further to the SIGRID and HDF formats;
sampling of actual ic e characteristics by definite intervals in space and time into the points of a grid area (conversion of the SIGRID and HDF formats into the GRID format);
interactive calculation on the basis of the data in the HDF format, temporal or spatial (by area, route, section) statistical characteristics (mean, dispersion, mode, quantile of an arbitrary level, probabilities of the appearance of a prescribed characteristics range, etc.) with the output of the results in the HDF and GRID formats;
interactive overview of both the initial and calculated data, presented in the HDF, KONTUR, and SIGRID formats, on the display screen and obtaining of a hard (half-tone o r colour) copy at the printer.

The indicated technology is implemented using original software for the computer system.

As per January 1994 the GDB of the AARI contains the folowing databases:

KONTUR-D, including the AARI data on the ice situation in the KONTUR format for the period from 1972 to 1990 with a 10-day frequency separately for the western and the eastern sectors of the Russian Arctic in the form of 1257 files, 14100 Kbites (there are gaps in the time series, mainly in the winter and spring period, the spatial coverage corresponds to the shipping zones and also to the zones significant for the forecast of the shipping conditions along the NSR);

SIGRID-D1, d erived from the KONTUR-D base and which includes the data in the SIGRID format for the period mentioned above in the form of 1257 files, 16772 Kbites;

SIGRID-D2, including the data on the ice situation of the WDC-A for Glaciology in the SIGRID format for the period from 1972 to 1991 in the form of 2080 files, 88750 Kbites (no gaps in the time series, the spatial coverage northward of 45 N is continuous);

HDF-S1W, derived from the KONTUR-D base and which includes the data on total and partial concentration and ice cover age categories for the western sector of the Russian Arctic for the equidistant grid area with a cell size 50x50 km in the HDF format;

HDF-G1 and HDF-G2, derivatives of the SIGRID-D1 and SIGRID- D2 and which include the data by layers on the total and partial concentration and age categories of the ice cover in the HDF format for the Western and Eastern sectors of the Rusian Arctic for the period from 1972 to 1990(91);

HDF-ST, the data of mean monthly and mean annual statistical calculat ions, made on the basis of the database HDF-S1W in the HDF format.

The databases SIGRID-D1, SIGRID-D2, HDF-G1 and HDF-G2 contain the data with a spatial interval 15x15 geographical minutes, the KONTUR-D - with an accuracy of the description of the zone boundaries - 1 minute.

When using both actual and generalized data of the WDC-B and the WDC-A it is necessary to take into account the following features:

an applied character of the data of the AARI and the climatic one of the WDC-A, which governs a different space coverage and consistency with the different period of acquisition;

the use of different sources during the preparation of the initial charts of the ice situation (a prevailing use of airborne visual observations for the AARI data and satellite microwave for the data of the WDC-A for Glaciology).

A comparison of the test data of the AARI and the WDC-A /2/ shows that having a good agreemnt by temporal tendencies, the data differ significantly by the values of partial concentration and sea ice age categories.

During the analysis of the ice conditions along the NSR a joint data procession is advisable and the priority in the information on concentration should be given to the data of the WDC-A, and on age categories - to the AARI data.

The GDB data in the interest of INSROP can be used to address the following goals:

estimates of the tendencies in the change of ice conditions along the NSR for the period of 1972-1991;

estimates of cl imatic (regime) characteristics of the ice cover along the NSR (probabilities of appearance of open water, open and very open ice, ice of a prescribed age category);

climatic modelling (as initial data).

The GDB, however, can be considered only one of the components of the regime-reference block of the information system, created for the support of transit navigation along the NSR. Databases containing the information on a wider range of natural characteristics governing the shipping conditions are required.

2 MAIN CHARACTERISTICS OF THE ICE COVER STATE

The ice cover of the Arctic Seas is composed of the ice, differing in age, shapes of ice formations, amount of fracturing, degree of destruction, concentration, degree of compacting, rafting, amount of hummocking, amount of hills and a whole number of other characteristics. During the airborne ice reconnaissance the observers on board visually assess the values of 12 standard characteristics of the ice cover state.In addition many other characteristics are used which considerably supplement the understanding of ice navigation. It is desirable to include those characteristics (traditional and non-traditional), which make the largest contribution to the formation of the shipping conditions and on which there are available representative enough data.

Basing on a multiyear experience of providing hydrometeorological services for navigation along the Northern Sea Route one can suggest the following preliminary content of the databases (by the components of the ice cover state):

concentration of ice of different age categories (governs the shipping conditions in the summertime);
ice cover thickness (governs the ice resistance to the ship's motion;
ice age category (in the data, absence serves as an indirect characteristic of ice thickness);
amount of hummocking (the degree of the ice being covered by the conglomerations of fragments of level ice);
ice pressure (consolidation of the ice cover after it reaches the concentration of 9/10-10/10, accompanied by rafting or hummocking);
leads and fractures (used for navigation in winter);
polynyas (stable area , occupied by open water or young ice, behind fast ice or near the shore, used for navigation of the ships);
amount of fracturing of the ice cover (the characteristics, determined by the mean distance between the cracks and leads or by a relative number of ice floes, affects the passage of the ships in the ice);
degree of destruction (degree of sea ice des truction in the process of melting, affects the shipping conditions in summer);
fast ice (immobile sea ice, formed along the coast, it is described by the position of its limits, it is taken into account during the choice of the navigation route);
ice forms (prevailing sizes of the ice floes of different age categories);
icebergs (present a navigation danger at a direct collision with the ship).

The ice data available at the AARI, extensive by volume and unique by content can be subdivided into three groups:

non-formalized archives;
data sets, recorded on tech ical (computer readable) media;
data bases, containing structured sets, management, service and processing softwares.

The non-formalized archives include the primary materials, as well as the charts of different scale, on which, using the arbitrary designations, the data of visual airborne observations and the results of a visual assessment of the ice situation from satellite images, and an operational indicator of the Side-Looking Airborne Radar Station are plotted. The archives of the AARI have the following materials:

data of visual airborne observations for 1933-1990 (about 35 thousands charts);
satellite data for the region of the North-European basin for 1985-1991 (506 charts);
satellite data for the Arctic Seas and the central Arctic for 1981-1991 (396 charts);
data of radar surveys from aircraft for 1968-1990 (96 charts);
composite data for 1933-1990 (1160 review charts);
data on the amount of ice fracturing for 1959-1986 (150 charts);
data on the degree of ice destruction for 1953-1980 (280 charts);
data on the amount of ice hummocking for 1953-1980 (220 charts);
negatives of satellite images of a small resolution fo r 1968-1991, received at the AARI (1100 copies);
neg atives of satellite data of a small resolution for 1985-1992 received at the drifting stations NP-22, NP-25, NP-26, NP-28 and NP-31 (13233 copies);
films (series of successive images) of radi o-echo sounding of the ice cover from aircraft, made in 1968-1992 (2234 films).

At present there is available at the AARI the following series of the data sets on technical media (part of them is included in the databases of the Global Data Bank of the AARI, which were listed in the preceding section):

monthly data on total concentration of sea ice in the points of a rectangular grid with a spacing of 60 nautical miles (the Arctic, the northern part of the Atlantic and the northern part of the Pacific Oceans, 1953-1990, 456 charts);
weekly data in the SIGRID format in the geographical grid points with a resolution of 15 minutes on total and partial sea ice concentration (western Arctic and the North Atlantic, 1972-1991, 1043 charts);
weekly data in the SIGRID format in the geographical grid points with a resolution of 15 minutes on total and partial sea ice concentration (the eastern Arctic and the northern Pacific Ocean, 1972-1991, 1043 charts);
every 10-day data in the SIGRID format in the geographical grid points with a resolution of 15 minutes on total and partial sea ice concentration (the western Arctic, 1972-1990, 571 charts);
every 10-day data in the SIGRID format in the geographical grid points with a resolution of 15 minutes on total and partial sea ice concentration (the eastern Arctic, 1967-1990, 592 charts);
every 5 day data in the SIGRID format in the geographical grid points with a resolution of 1 degree by latitude and 2 degrees by longitude on total sea ice concentration (the Sea of Okhotsk, January-May and December of 1971-1990, 720 charts);
every 5 day data in the SIGRID format in the geographical grid points with a resolution of 15 minutes on total sea ice concentration (the Sea of Okhotsk, January-May and December, 36 charts);

every 10-day data in the KONTUR format on total and partial sea ice concentration (western and eastern sectors of the Arctic, 1933-1990, 2289 charts);

daily coordin ates of the drifting ships, stations, buoys and radiomarks (the Arctic basin, 1893-1985, 184 targets);

daily coordinates of the drif ting radiomarks and DARMS (the Arctic basin, 1953-1972, 286 targets);

daily coordinates of the "North Pole" drifting stations by astronomical observations and positioning by means of the space navigation systems (the Arctic basin, 1937-1991, 31 stations);

data in the KONTUR format on total and partial sea ice concentration with an average period of 3-7 days (the western Arctic , 1985-1992, 490 charts);

geographical coordinates and the amount of icebergs (the northern parts of the Barents and the Kara Seas, 1936-1989, 15354 records);

geographical coordinates and geometric dimensions of the icebergs (the Barents Sea, 1989-1991, 676 records);

data of drifting buoys: coordinates, air and ice temperature, pressure tendency (the Barents Sea, 1989- 1990, 1992, 13 buoys);

data on the beginning of a stable ice formation in the pseudo-KONTUR format (the Siberian shelf seas, 74 charts).

The AARI carries out an active effort to set up the ice databases. One of the bases, fully prepared for use, appears to be the database on the degree of ice destruction of the Arctic Seas from the Barents to the Chukchi Sea. According to the technology 4 main and 3 intermediate bases are to be established:

Kontur-D, includes the data on the degree of ice cover destruction in the format "Kontur" in the form of 516 files, 4100 Kbites;

Sigrid-D, includes the da ta on the degree of ice cover destruction in the Sigrid format in the form of 516 files, 4400 Kbites;

Grid-S, includes the data on the degree of ice cover destruction for the grid area with a 50x50 km spacing in the GRID format in the form of 516 files, 10177 Kbites;

HDF-S, same data, as GRID-S in the HDF format in the form of 1 file, 1697 Kbites;

HDF-ST, the data of the statisti cal 10-day period calculations, made on the basis of the database HDF-S in the HDF format in the form of 12 files, 909 Kbites.

The technology for the procession and the formation of the database on the degree of ice cover destruction uses the following software:

conversion s oftware KONTUR for digitizing ice data, presented in the form of the chart on hard medium;

conversion s oftware ICEMAX, for the reconstruction of the chart of ice characteristics from the KONTUR format into the equidistant rectangular grid area, visualization of the map, interactive statistical calculations and the subsequent conversion to the SIGRID and GRID formats;

conversion software SIMAX, for the reconstruction of the chart of ice characteristics from the SIGRID format into the rectangular grid area with a subsequent visualization on the monitor screen in the Merkator projection with the possibility of scaling, interactive calculations and conversion into the GRID format;

conversion software WMAX HDF, for data conversion from the GRID format into the HDF format;

WMAX software, for visualization of the format data in the stereographic and Merkator projections with the plotting of the geographical grid with the possibility of fragment scaling, interactive or automated calculation of the climatic characteristics in the grid points (distribution histograms of the characteristics, mean, dispersion, mode, quantiles of an arbitrary level, probability of the appearance of the given range, spectrum).

The software is for computer processing in the DOS 4.0 version and higher.

3 ICE THICKNESS

Ice thickness is considered one of the most informative characteristics of the ice cover state. Up to the present, however, no reliable methods of remote sensing these diagnostics of these characteristics have been developed. When addressing the navigation goals in the NSR zone the data on the ice age categories are usually used, allowing for a rather rough assessment of the thickness distribution. Another information source on the ice thickness appears to be regular measurements at the permanent points at coastal polar stations, which are carried out during the entire annual cycle of fast ice existence. The data collected at the stations serve as a basis for the development of physical-statistical and numerical models, calculation and forecasting methods for ice thickness distribution (Gudkovich et al., 1972).

The data from polar stations do not always allow for the estimation of the conditions in the open part of the sea. That is why, in spite of large difficulties, ice thickness measurements and related characteristics (ice draft and elevations above sea surface, geometry of hummocked formations, snow depth) were carried out in various regions on ice in different stages of development and state and first of all by means of drilling.

As a result, a vast archive was accumulated at the AARI. Unfortunately, this abundance of data has not yet been systematized. One of the main reasons is the large non-uniformity of initial data, obtained in the absence of common methods of measurement taking into account ice age category, amount of hummocking, degree of destruction and other ice cover features.

The AARI carries out the work on combining in one database the results of direct ice thickness measurements and related characteristics in various regions of the Arctic Ocean. An important component of this work appears to be the preparation and maintenance of the expedition catalogue with the information on when, where, how and what characteristics were measured. By the present time part of this catalogue is prepared, which includes the data on ice thickness measurements in the Arctic basin for the period 1937-1991 (in total about 13 000 measurements). The material in arranged depending on the organization of measurements (areal surveys, profile measurements point measurements, also at polar stations at a constant point).

In addition, the zoning of the Arctic basin and its marginal seas by similar formation conditions and ice thickness evolution has been made. And at first large regions were identified, which are characterized by the presence of fast ice or drifting ice. These regions were divided into smaller ones considering the age categories, snow feature distribution and dynamic factors.

Work on the formation of the structure of the database and filling it with information has been started. The ice measurements data at 19 polar stations for 1933-1968(at some stations since 1917), at the drifting stations NP-13 for 1964, Np-16 and NP-18 for 1970 were prepared for input and recorded on technical media.

The database structure will be open (easily expanded), allowing for the combination of data, obtained using different methods of measurement over a large time interval in different regions of the Arctic Ocean, as well as the information on the methods of data collection, their reliability and accuracy.

The main emphasis in the structure under development is given to the organization of relationships inside the database, as well as to the interaction with other databases in the system. As a system for database management (SDBM) the PARADOX 4.0 package was selected and adapted, which provides for the grid and multiplex opweration modes (the system of blockings allows one to simultaneously handle the data of several users).

For the statistical procession of profile measurement data the algorithms and software for checking and correction of the observation data, as well as the software for visualization of the ice thickness profile have been developed.

4 THICKNESS, LEADS AND FRACTURES IN THE ICE COVER

The navigation of ships in the Arctic in the fall-winter and winter-spring period is carried out by using the discontinuities in the ice (break ups), appearing in the form of cracks, leads and fractures and forming as a result of the dynamic factors (Gorbunov, Losev, 1975, Gorbunov et al., 1986, Brestkin et al., 1988). The velocity of the ship's motion in the presence of cracks or leads many times exceeds the motion velocity in compact ice approaching in some cases the velocity in open water.

The majority of the initial data consist of satellite images in the IR and TV range. Their resolution allows for estimates of break ups more than 300 m wide.

Along with the satellite data there is information about the cracks, leads and fractures obtained during visual airborne ice reconnaissance flights. However, the materials of ice reconnaissance do not contain the data on the extent of the break ups, and the orientation values given in them appear to be very rough. The data on the width of the crossed discontinuities and the distances between them are more reliable. The data on visual airborne ice reconnaissance are summarized for all seas of the Russian Arctic for the period from 1959 to 1986.

The survey data from the Side-Looking Airborne radar are considered promising from the point of view of obtaining data on discontinuities in the ice. The radar surveys allow for the determination of the break ups from 40 to 50 m wide and more. There are films available at the AARI (more than 2000) of numerous radar ice surveys in all Arctic Seas for the period from 1968 to 1992, but processing is not done due to the absence of money.

Taking into account the large value of the regime information about the discontinuities in the ice cover both for science and practice the AARI has started work to set up a corresponding database. At the initial stage only satellite images of all types of the initial data were used. In future the base can be supplemented by data from other sources.

The maps of the leads and fractures in the Kara, Laptev, East-Siberian, Chukchi Seas (the stereographic projection, the scale in the Kara Sea being 1:5 000 000, in other seas - 1: 10 000 000) are made from satellite images. To construct one map the images obtained for the period from 2 to 5 days are averaged. The data for the Kara Sea are obtained for 8 years, for other regions - for 5 years.

The number of observations in different years is not equal (Table I). The largest number of the maps is made during spring months, when the cloud occurrence is small and the daylight period is quite long. The data of the coordinates of the ends of the comparatively rectilinear lead segments (such segments at the extent of which the direction changes not more than by 10 degrees) are taken from the maps and entered into the database. At present with regard to the Kara Sea all the prepared charts have been entered into the database, the information on other seas is entered only for 1979-1981.

The structure of the database on the discontinuities has been developed which provides in most cases the most quick access to the information when it is grouped according to different combinations of the signs.

The purpose of the set of processing and service programs is to group the data by the regular grid squares, prescribed regions and periods, the calculation and presentation in different form (tables, diagrams, maps) of the generalized characteristics of discontinuities (specific length, orientation distribution, modal direction, occurrence of the modal interval, resulting direction,

measure of the direction scattering, distribution of the distances between the break ups at different directions of the sections).

The algorithms and software have been developed, the purpose of which is:

to form the initial information file and reference-files;

to prescribe the periods and averaging regions, data procession modes, forms for presentation of the results;

to calculate the characteristics of the number and direction of the discontinuities;

to determine the occurrence of the gradations of the distance at a different orientation of the motion route with regard to the system of break ups;

to obtain the output calculation results in the form of the maps with isolines, values of characteristics or oriented segments;

to present the calculation results by the display on the monitor screen or printer output in the table form or diagram rose.

Table 1. The number of maps with leads and fractures in the Arctic Seas.

Period	YEARS								
	1979	1980	1981	1983	1987	1991	1992	1993	For all year
January-March	-	-	1	16	25	-	1	12	55
April-May	11	10	9	10	10	5	7	11	73
For a year	11	10	10	26	35	5	8	23	128

Period	YEARS					For all years
	1979	1980	1981	1982	1983	
the Laptev Sea						
January-March	-	-	12	8	18	38
April-June	10	12	14	8	11	55
July-September	-	-	5	1	-	6
October-December	-	7	7	4	-	18
For a year	10	19	38	21	29	117
the East-Siberian Sea						
January-March	-	-	13	4	16	33
April-June	9	13	14	13	12	61
July-September	-	1	-	3	-	4
October-December	-	9	4	3	-	16
For a year	9	23	31	23	28	114
the Chukchi Sea						
January-March	1	-	8	-	16	25
April-June	1	3	12	2	7	25
October-December	-	8	3	4	-	15
For a year	2	11	23	6	23	65

5 FAST ICE AND FLAW LEADS

The position of the external fast ice boundary and the state of the drifting ice near it govern to a large extent the conditions for transit navigation of the ships along the highlatitudinal routes in the spring period. With the presence of ice free polynyas behind fast ice or covered by young ice, navigation on some segments of the route does not present any difficulties.

During the routing of the ships by icebreakers across fast ice the channel is broken taking into account the distribution of the amount of ice hummocking and thickness. The data on the amount of hummocking and thickness of fast ice are entered into the bases along with the corresponding data on the drifting ice characteristics.

Monthly (in some years every 10-day) data on the thickness of fast ice boundaries and flaw polynyas at about 570 charts are recorded onto technical media in the KONTUR format together with the data on total ice concentration and ice amount of different age categories for 1933-1990.

6 DISTRIBUTION OF THE ICE FLOES BY SIZE

The horizontal dimensions of the ice floes affect the ice resistance to the ship's motion (Buzuyev, Ryvlin, 1969). The zone of medium floes and broken ice with concentration of 9-10/10 is passed much easier than a vast floe. That is why in extimating the possibilities of ice navigation it is important to know the distribution of the floe dimensions. It is described by the function of the relative areas, occupied by the sets of the floes with the diameter more than the prescribed ones (Gorbunov, Losev, 1981, Losev, Gorbunov, 1977, Losev 1979). The data on the Arctic seas of Russia, obtained as a result of the processing of these processing materials are not yet numerous. Their total summary is given in Table 2. The generalized information is recorded on paper media. There is, however, a considerable amount of unprocessed data. They include the radar ice surveys for 1968-1992, carried out during ice reconnaissance flights, especially in the Kara, East-Siberian and Chukchi Seas.

There are also rough data on the fraction of the area of ice floes with cross-sections from 0.5 km and more in the total ice area, obtained from the visual ice reconnaissance data. These data are summarized for all the seas of the Russian Arctic for the period from 1953 to 1986.

Table 2. Main information about the data obtained using instrumental surveys for the statistical assessment of the areal fraction of the ice floes with different diameters in the total area of drifting ice

Observa-tion time (year, month, 10-day period)	Survey type	Survey place	Scale	Area from which the data are received	Ice concentration (change limits/ mean) %	Measured characte-ristics	Low threshold value of theice floe diameter, km	The largest recorded ice floe diameterkm	Number of measured ice floes
1963, July, first 10-day period	APS	the East-Siberian (E-S) sea in the area of the point 76N, 165E	1:10 000	300	90-100/94	l	0,02	3,0	3271
1963, July, second 10-day period	APS	the E-S sea, in the area of the point 76N, 165E	1:10 000	580	90-100/96	l	0,02	2,9	7281
1963, August, second 10-day period	APS	the Laptev sea, in the area of the point 74N, 114E	1:10 000	51	10-80/20	l	0,02	0,6	3863
1963, September, first 10-day period	APS	the Laptev sea, in the area of the point 74N, 114E	1:14 000	250	8-97/41	l	0,02	0,7	534
1969, June	APS	the E-S sea, in the area of the point 77 40 N, 162 00 E	1:10 000	339	85-100/93	l	0,02	4,7	877
1969, July, third 10-day period	APS	the E-S sea, by the route: Medvezhy cape Chetyrekhstolbovoy island-B.Baranov cape	1:50 000	1320	10-70/29	l,h	0,10	1,3	5500
1969, August, second 10-day period	APS	the E-S sea, in the area of the point 7650N, 161E	1:10 000	69	80-88/85	l	0,02	2,4	447
1969, September, third 10-day period	APS	the E-S sea, in the area of the point 7730N, 16230E	1:10 000	97	90-100/95	l	0,02	5,9	257
1971, August, second 10-day period	APS	the E-S sea, by the route: B.Baranov cape, Aion island-Chetyrekhstolbovoy island- B.Baranov cape	1:50 000	2910	10-40/13	l	0,10	0,9	4500
1972, July, second 10-day period	APS	the E-S sea, in the area of the point 7242N, 17030E	1:50 000	100	90-100/94	l,h,s	0,045	3,0	2340
1972, July, second 10-day period	SLAR	the E-S sea, in the area of the point 7236N, 16930E	1:200000	553	90-100/95	l,h,s	0,8	6,5	280
1972, August, third 10-day period	SLAR on the polygon	the Kara Sea, between the islands of ay Geiberg, Pravda, Isachenko, October revolution	1:200000	45000	100	l,h	5,0	19,2	180
1973, July, third 10-day period	APS	the Chukchi sea, in the area of the point 7055N, 177W	1:20 000	27	55-65/61	l,h,s	0,08	3,2	542

Observa-tion time (year, month, 10-day period)	Survey type	Survey place	Scale	Area from which the data are received	Ice concentration (change limits/ mean) %	Measured characte-ristics	Low threshold value of theice floe diameter, km	The largest recorded ice floe diameterkm	Number of measured ice floes
1973, August, first 10-day period	APS	the Chukchi sea, to the north-east of the Wrangel island	1:20 000	162	10-85/55,4	l,h,s	0,08	7,3	1721
1976, July, second 10-day period	APS, of the polygon	the Laptev sea, delta of Lena river, on the eastern coast	1:107000	11600	70-100/86	l,h,s	0,7	20,8	1686
1976, July, third 10-day period	SLAR of the polygon	the Laptev sea, delta of Lena river, eastern coast	1:200000	16300	20-100/61	l,h,s	0,7	17,8	1640
1976, August, second 10-day period	APS	the south-eastern Laptev sea	1:4 000	3	30-50/36	l,h	0,012	0,94	500

Note: APS - aerial photo survey, SLAR - radar survey by the Side-Looking Aiborne radar, l - the largest ice floe diameter, H - the largest ice floe section by normal to l, s - floe area.

7 ICE DRIFT

Ice drift is necessary to take into account when calculating ice redistribution by concentration and age categories, location of the ice compacting and diverging zones, characteristics of leads and fractures.

The information sources on ice motion in the Arctic seas are as follows:

automated buoys, set up on the drifting ice floes, the co ordinates of which are determined by means of navigation satellites:
radiomarkers, the bearings of which are taken by the coastal bearing finders;
the "North Pole" dri fting stations, the coordinates of which are determined by means of astronomical observations or navigation satellites;
repeated radar surveys of the ice cover from aircraft;
repeated aerial photography survey of the ice cover;
theodolite observations at polat stations.

The coordinates of the automated buoys are available for the period 1979-1990 with a daily interval. The data volume constitutes about 4500 coordinate values. More than 90% of the information refers to the northern regions of the Chukchi and the East-Siberian Seas. The data are recorded on computer readable media.

The coordinates of the radiomarkers are available for the period of 1953-1975 with a 5-10 day interval. The data volume is more than 12700 coordinate values, and 60% of the information concerns the East-Siberian Sea. The data are on computer readable media.

The coordinates of nine "North Pole" drifting stations are available for the northern East-Siberian Sea during 59 months for the period 1957-1981 with an interval of 1-7 days and during several months in 1987 in the northern Laptev Sea with a 1 day interval. The total data volume does not exceed 700 coordinate values. The information on the coordinates is recorded onto computer readable media.

The radar survey of the ice drift was carried out at the test sites in six large regions of the Arctic seas:

between the Beliy and Dikson islands (November-December of 1972 and 1973);
between the Graham-Bell island of the Franz-Josef Land archi pelago and the Komsomolets island of the Northern Land archipelago (April-May 1984);
in the north-eastern Kara Sea (August 1972);
in the north-western Laptev Sea (November 1979);
in the south-eastern Laptev Sea (July-August 1976);
in the south-eastern East-Siberian Sea and the western Chukchi Sea (May 1969, July 1971, July 1973, July 1975).

As a result of the processing of the survey data, about 3000 vectors of the ice drift for the intervals from 2 to 6 days were obtained, presented in the form of 28 ice drift diagram-charts of the indicated regions.

Also, in the south-western Kara Sea in 1972-1982 in the wintertime more than 100 ice cover radar surveys were made at the test sites, the processing of which will allow one to obtain 70-80 ice motion diagrams at different pressure situations with a average interval of several days.

The aerial photosurvey of the ice drift was made in the coastal regions of the East-Siberian and the Chukchi Seas in July-August of 1965, 1969 and 1971 on the scale of 1:50 000 or 1:30 000 along the routes of a total extent of 1120 km at an interval of 1-2 hours. As a result of the survey, data processing of more than 10 500 ice drift vectors was obtained, presented in the mapped form.

In July of 1977 the aerial photosurvey of the ice drift in the Long strait was made by two routes of 145 km extent each on the scale of 1:50 000 with a 1.7 hour interval. The data processing is not completed.

The aerial photo survey of the ice drift in the Vil'kitsky strait is made. The data are not processed.

The theodolite observations of the ice drift were carried out at more than 40 polar stations in summer. The data are stored in personal archives in the table form.

The results of the analysis of instrumental observations of the ice drift in the Arctic seas are presented in numerous articles, published in the AARI Proceedings and the journal "The Arctic and Antarctic Problems".

8 ICEBERGS OF THE ARCTIC SEAS

The main data source on icebergs appear to be the charts of the airborne ice reconnaissance (visual and radar) for the period from 1936 to 1991, available at the AARI, the Arkhangelsk and Murmansk Administrations of the Hydrometeorological Service. Also the data of shipborne observations for the period from 1881 to 1993 are used, which, although having an occasional character, provide valuable information on the position and the characteristics of icebergs in regions where there were no flights or they were rare.

The PARADOX package was used as a Database Management System. The format for recording data on icebergs includes the following characteristics:

successive recording number;
observation date;
geographical coordinates;
number of icebergs;
observation method;
the shape of the part above water;
length;
width;
height of the part above water;
colour of the iceberg ice.

The records are sorted by regions: the Barents Sea, the Kara Sea, the Laptev Sea, the East-Siberian Sea, the region, adjacent to the Franz-Josef Archipelago.

At the time of the Report the database includes the following information:

for the Barents Sea - information on 1 0765 icebergs from 1135 ice reconnaissance flights for the period 1936-1992;

for the Barents Sea - information on 758 icebergs from the data of 99 shipborne observations for 1881, 1928-1930, 1932, 1935, 1971, 1972, 1980, 1982 - 1984, 1989 - 1992;

for the Kara Sea - information on 9060 icebergs from the data of 1294 airborne ice reconnaissance flights for the period 1936 - 1991;

for the Kara Sea - information on 338 icebergs from the data of 29 shipborne observations for 1930, 1932, 1933, 1934, 1935, 1940, 1980, 1983, 1984, 1992;

for the Franz-Josef Land - information about 28939 icebergs from the data of 1083 airborne ice reconnaissance flights for the period 1936 -1992;

for the Franz-Josef Land - information on 754 icebergs from data of 34 shipborne observations for the years 1928, 1932, 1968, 1972, 1983, 1984, 1990, 1992.

The database on icebergs in the Laptev, the East-Siberian and the northern Chukchi Seas is being formed.

In total the database contains data on about 50 000 icebergs.

9 THERMOHALINE AND HYDROCHEMICAL CHARACTERISTICS

The data from marine and airborne expeditions which carried out studies in the seas of the Siberian shelf, beginning from the end of the last century up to the present, serve as an information base for the oceanographic databases on the NSR.

The database on thermohaline and hydrochemical characteristics is being created on the basis of raw observation data, archived at the AARI.

The database includes the following characteristics: temperature, salinity, oxygen, silicon, phosphorus, pH. In the context of the goals addressed in Subprogram I only first two characteristics appear to be of interest, however, the data on hydrochemistry are necessary in the other INSROP subprograms, in particular in Subprogram III.

To date about 20 000 observations at the oceano-graphic stations have been carried out in the regions adjacent to the NSR, each of them including on an average measurements at 12 levels. In all cases temperature and salinity are measured. The hydrochemical measurements cover about 25% of the total number of stations.

The observations are distributed by regions and observation periods as follows. During the summer navigation period the observations in the Siberian shelf seas were carried out:

in the Kara Sea in 1960, 1967, 1971-1983, 1985-1988, 1990-1993 (in total for 24 years at 4500 hydrological stations);
in the Laptev Sea in 1969-1985, 1989, 1990, 1991, 1993 (in total for 21 years at 2000 hydrological stations);
in the East-Siberian Sea in 1961, 1962, 1964, 1972-83 (in total for 13 years at 1300 hydrological stations);
in the Chukchi Sea in 19 63, 1969-92 (in total for 25 years at 4300 hydrological stations).

Also, during the period from 1937 to 1993 the observations in the northern parts of the Siberian shelf seas (winter) and in the adjacent parts of the Arctic basin (all year round) were carried out in total at 9 000 hydrological stations.

The oceanographic database, set up on the basis of this information will include interrelated tables of two kinds:

data on oceanographic stations;
oceanographic data at the levels.

The package dBase III + (in the DOS operation system) and FoxPro (in the Solaris operation system) will be used as the Database Management System (DMS).

The database will contain the original software, part of which has already been developed. The main software functions will be:

passport station control;
data reality control;
station completeness control;
data consistency control depending on regional variability;
text file conversion;
data sampling and sorting by the range of geographical coordinates, time, values of characteristics, depths.

10 BRIEF INFORMATION ON THE AVAILABLE DATA

In addition to the data described above there are also other data, which can be used to set up the databases in the framework of the INSROP. A brief review of these data is presented in Table 3.

Table 3. Brief information on the available data

Data list	Observation period	Time interval, source	Presentation form	Number of cases
1	2	3	4	5
1. Daily air temperatures for the Arctic stations	from 1949	-	paper media	-
2. Daily wind values for the Arctic stations	from 1949	-	paper media	-
3. Mean monthly air temperature	from 1881	-	magnetic disks	233 stations
4. Mean monthly wind direction occurrence by 16 sectors	from 1932	-	magnetic disks	22 stations
5. Meridional and latitudinal gradients of mean monthly pressure	from 1900	-	magnetic disks	8 sections
6. Pathways of cyclones and anticyclones by elementary synoptic period	from 1940	daily	maps	4 640
7. Mean monthly surface pressure	from 1900	-	magnetic disks	233
8. Mean monthly maps of air temperatures and their anomalies	from 1881	-	maps	1 332 x 2 maps
9. Pressures in the ice cover of the Arctic seas (by a 3 arbitrary unit scale)	1960-1988	during airborne ice reconnaissance and by shipborne data	paper media	3 500

Data list	Observation period	Time interval, source	Presentation form	Number of cases
1	2	3	4	5
10. Adhesion of the ship's hull on the NSR (by 5 unit scale)	1970-1980	by shipborne data	paper media	500
11.Atmospher icing	1956-1993	-	paper media	20 000
12. Spray icing by shipborne data	1948-1993	-	paper media	100
13. Swell by data of the Arctic stations	1950-1991	-	paper media	-
14. Sea level by data of the Arctic stations	1950-1991	-	paper media	-
15. Extreme sea level values for a month from data of the Arctic stations	1950-1991	once a month	paper media	500
16. Mean monthly sea level values from data of the Arctic stations	1950-1991	once a month	paper media	500
17. Currents in the 0-25 m layer	1930-1989	long-term observations at buoy stations and from fast ice	magnetic tapes and disks	-
18. Database on tidal currents	1956-1989	tidal harmonics are calculated by data of direct measurements	magnetic tapes and disks	-

11 DATABASE ON ICE AND METEOROLOGICAL CONDITIONS ON STANDARD AND OPTIMAL NAVIGATION ROUTES ALONG THE NSR

The study of the ice cover as a shipping medium, as well as a wide range of the objectives connected with the organization of shipping along the NSR, require the analysis of data on natural conditions, first of all, ice conditions, directly on the way of the ship motion (during navigation by standard, optimal or the easiest variants).

A vast amount of full-scale data, accumulated at the AARI, was used for the formation of data sets on the distribution of ice cover characteristics on the navigation route, on the basis of which a specialized database can be set up.

As a main parameter of the ice navigation conditions the extent of the route in the ice with different characteristics (age category, concentration, amount of hummocking, etc.) is used. These data are taken from the composite ice charts, on which the standard and optimal navigation variants are plotted.

11.1 Database content

To create the database on ice conditions along the navigation routes the composite ice charts are used.

Up to the end of the 70s the ice charts contained airborne data. During 1980-1985 with the development of satellite methods for the diagnostics of sea ice, the 10 day period ice charts have become of a composite character (the data, obtained by different methods were generalized on them). Since 1985 the composite charts are based on satellite images (in the IR, TV and radar ranges). The period of ice data generalization on a composite chart is 5-7 days since 1990.

A uniform ice zone, identified on the composite charts, is a key notion, used during the formation of the database on ice conditions. The zone is considered uniform if during the passage of it all characteristics of the ice cover state vary within the accuracy of the observations (Bushuyev et al., 1967). The ice zone characteristics are:

the extent of the route in the uniform ice zone;
the ice cover state characteristics.

The List of the characteristics, determined from the composite ice charts is presented in Table 4.

The mean values of the length of the route segments in the ice of different forms (equivalent dimensions) are significantly less than the mean horizontal dimensions, indicated in the "Nomenclature" (International Ice Symbols, 1984). This feature is governed by a selective character of the ship motion in the ice (Buzuyev, 1975). The values of the equivalent dimensions are obtained on the basis of the calculations by the summarized shipborne observation data in summer (Table 5).

Table 4. Ice characteristics, determined from the ice charts

Characteritics	Measurement units tenths	Variation limit
Concentration	arbitrary units	0-10
Amount of ice of a specific age category	arbitrary units	0-10
Equivalent extent of the prevailing drifting ice forms	meters	30-500
Amount of hummocking	arbitrary units	0-5
Degree of destruction	arbitrary units	0-5
Pressure degree	arbitrary units	0-3
Snow depth on level ice	cm	0-30

Table 5. Equivalent dimensions (m) of the ice formations, penetrated by the ship (August)

Ice age category	FORMS				
	Vast floes, floes	floes	floes, medium floes	medium floes, broken	broken, ice cake
young, first-year thin	500	300	200	150	30
first-year medium	300	200	150	125	30
first-year thick	200	175	125	100	30
second-year, pack ice	175	150	100	50	30

The equivalent dimensions of the ice formations on the navigation route in other seasons are obtained by multiplying the values, given in Table 5 by the correction coefficient (Table 6).

Table 6. Values of a seasonal correction coefficient to calculate the equivalent dimensions of ice formations

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Coefficient	1,5	1,5	1,4	1,3	1,2	1,1	1,1	1,0	1,1	1,2	1.3	1,4

The airborne data and satellite images contain only the information on the ice age gradations, to which the certain gradations of its thickness correspond. That is why to make the ice thickness estimates more specific its mean values were obtained (Buzuyev et al., 1982) for each age gradation (Table 7).

In the summertime the ice thickness decrease due to its melting is calculated by the method of Shesterikov (Buzuyev et al., 1976), as well as by the empirical relationships (Buzuyev et al., 1982).

The data of ice reconnaissance flights contain data on snow amount in arbitrary units. For the transition from the snow amount in arbitrary units to the snow cover thickness the ratios given in Table 8 are used.

Table 7. Mean thicknesses of the ice of different age categories

Ice age category	Thickness change limits DH, cm	Months								
		IX	X	XI	XII	I	II	III	IV	V
Nilas	5-10	5	5	5	5	5	5	5	5	5
Grey ice	10-15	12	12	12	12	12	12	12	12	12
Grey-white ice	15-30	20	20	20	20	20	20	20	20	20
First-year thin	30-70	30	30	40	40	50	50	60	60	60
First-year medium	70-120	-	-	-	70	70	85	100	110	120
First-year thick	see notes									
Second-year (old)	180-270	180	180	180	200	200	220	220	250	250
Multi-year (pack ice)	300-420	300	300	300	300	320	320	350	350	350

Notes: the thickness of the first-year thick ice is calculated by the formula of Shesterikov (Buzuyev et al., 1976).

Table 8. Mean snow depth on level ice depending on the amount of snow (Nomenclature, 1974)

Snow amount, arbitrary units	Mean snow depth, cm
0-1	2
1	5
1-2	10
2	15
2-3	20
3	30

11.2 Methods for the formation of the database

When choosing the optimal ice navigation variant, the following is taken as a basis:

the motion is made by the shortest way;
ice concentration and total extent of the ice zone are minimal;
the amount of young ice and small forms of ice formations is maximum;
the amount of hummocking is minimum.

While in the summertime the choice of an optimal variant depends on the whole on the location and the limits of the ice massifs, in the winter-spring navigation period the choice of an optimal variant is governed in each specific case by:

the position of the ice edge (in the Barents and the Chukchi Seas);
the state of the flaw polynyas;
distribution of the dynamically-active zones (pressures or break ups in solid ice cover) in the ice massifs.

It is taken into account that the navigation route should pass by the depths, guaranteed for the modern icebreakers (more than 20 m).

Thus, the general rules for the preparation of the input data are as follows:

a. an optimal navigation variant is delineated by the composite ice charts in accordance with the above mentioned requirements;

b. from the variant chosen the following is taken:

the extent of the way in a uniform ice zone,
t he ice cover characteristics (concentration, age gradations, prevailing forms, amount of hummocking, degree of destruction, amount of snow, pressure degree);

c. the equivalent dimensions of the ice formations (forms, mean thickness of the ice of different age categories, mean snow depth are determined from the ratios presented in the corresponding tables.

11.3 The varions route segments

Up to the present time during the formation of the database the NSR has been subdivided into the segments, the choice of which has been governed by the main cargo flows of the operating transportation system of the country. The data on ice navigation conditions were determined on the following segments:

ice edge in the Barents Sea - Dikson island;
Dikson island - Khatanga Bay;
Khatanga port - Tiksi port
Tiksi port - mouth of the Kolyma river;
mouth of the Kolyma river - the Shelagsky cape;
the Shelagsky cape - the Bering strait.

Naturally, for the study of ice conditions for the transit navigation along the NSR (without the calls at the intermediate ports) such division of the route is not reasonable. A different division of the NSR has been suggested for the transit shipping. The main principle for the route division is the existence of the ice cover, the position and the dynamics of the development of which significantly affect the success of the navigation. The boundaries of the segments are governed by the limits of the ice massifs during their maximum development (Table 9). The names of the identified segments is consistent with the names of the respective ice massifs.

Within the delineated route segment depending on the general ice cover distribution the position of the optimal navigation variant can significantly change.

One distinguishes the central and the southern variants of the optimal route on the Novozemel'sky segment. On the Taimyr segment - the central and the southern, on the New-Siberian - the Sannikov strait and the variant northward of the New-Siberian islands, on the Aion - the central and the southern, on the Wrangel - the De Long strait and the variant northward of the Wrangel Island. These features of the choice of an optimal route are taken into account in the database structure.

A "temporal" database structure is governed by the period of the generalization of the data on ice cover distribution during the preparation of the ice charts, and mainly corresponds to a 10 day period. Due to this the data on ice navigation conditions are presented with a 10 day interval on each NSR segment established. It should be noted that the data obtained by means of monthly aircraft surveys (in winter) are referred to the second 10 day period of the corresponding month.

Table 9. The NSR segments and their boundaries

The NSR segment	Boundaries
Novozemel'sky	The Novozemel'sky straits (in winter - the ice edge in the Barents Sea) - a line connecting the Zhelaniya cape - Dikson island
Severozemel'sky	a line, connecting the Zhelaniya cape - Dikson island - the Cheluskin cape (for the winter-spring period - the eastern fast ice edge is in the B.Vil'kitsky strait)
Taimyr	the Cheluskin cape (eastern fast ice edge in the B.Vil'kitsky strait) - meridian 140E
New-Siberian	meridian 140E - meridian 160E
Aion	meridian 160E - a line, connecting the Billings cape - Blossom cape (Wrangel island)
Wrangel	a line, connecting the Billings cape - Blossom cape - the Bering strait

Notes: * - in the case of the location of the optimal navigation variant around the Zhelaniya cape, the ice edge in the Barents Sea is considered to be the western boundary.
** - in the case of the location of the optimal navigation variant north of Wrangel island, the meridian 180E is considered to be the eastern boundary of the segment.

11.4 Current state of the database on the ice navigation conditions

The ice conditions for the standard navigation variants (taking into account calls at the intermediate ports) are assessed on the basis of the 10 day charts of airborne ice reconnaissance for the period from 1946 to 1969. The standard variants are chosen as a result of the generalization of a multiyear experience of the Arctic navigation. As a rule,more favourable ice conditions are formed on them. The data are presented in the form of the tables of the extent of the way in the ice with concentration of 1-3/0, 4-6/10, 7-8/10, 9-10/10, as well as in fast ice. For the zones with concentration of 7-8/10 and 9-10/10, the prevailing forms,the amount of hummocking and degree of destruction, as well as the prevailing ice thicknesses,the amount of old and young ice are determined. Along with the data on ice navigation conditions there is an amount of meteorological information, obtained from the data of polar stations, which characterizes the weather conditions in the shipping regions (data, generalized for a 10 day period on the velocity and wind direction, air temperature, number of days with fog). The data are on paper media.

The ice conditions on the optimal navigation variants (taking into account the calls at the intermediate ports) are estimated on the basis of the 10 day charts of airborne ice reconnaissance. They are generalized and systematized for the period from 1946 to 1987. The

presentation form of the processed results coresponds to the presentation form of ice conditions by standard variants. The data on weather conditions in the regions of the shipping routes are available for the period from 1946 to 1969. The data are on paper media.

For the transit navigation on the NSR (without calls at the intermediate ports) there are data on the extent of the route in the ice of various concentration for the period from 1960 to 1979. The extent of the route is estimated by the optimal navigation variant for the ice with 0 concentration (open water), 1-6/10, 7-8/10, 9-10/10 and fast ice. The data are on computer readable media.

11.5 Prospects for the development of a specialized database

The database allows one to present the navigation conditions in the form of the distribution of the way extent in the following ice zones:

open water;
ice on the whole;
young ice (less than 30 cm thick);
polynyas;
very open ice (1-3/10 concentration);
open ice (4-6/10 concentration);
ice massif (7/10 concentration and more, ice thickness - 30 cm and more);
massif core (ice concentration 7/10 and more, ice thikness - 120 cm and more);
massif periphery (ice concentration 7/10 and more, ice thickness from 30 to 120 cm).

The information can be presented in the form of the distribution of the extent of the way in the ice of different age categories, amount of hummocking, degree of destruction, amount of snow.

Further development of the considered database is possible by creating additional information blocks.

Thus, it is proposed to set up a block of the operating parameters of the navigation difficulty. The calculation of the ice operating navigation velocity (V) within a uniform ice zone and its derivatives (time losses to penetrate a uniform zone, the navigation coefficient difficulty (Buzuyev et al., 1976) are made by means of the method for a quantitative assessment of the difficulty of navigation ("QAD"), developed at the AARI. All input parameters, required by the "QAD" method are contained in the database formed.

Also, it seems to be promising to set up a block of the actual ice-operating parameters of the transit voyages along the NSR, such as reference data on ice navigation conditions. This block can be based on the results of special shipborne observations, carried out by the AARI specialists during transit voyages.

The most important trend in the development of the database under consideration appears to be the automated assessment of the initial characteristics on the chosen navigation variant, as well as the automated choice of the variant itself. In the future the databases by elements, the description of which is presented in sections 1-11, should be used for this.

12 GENERAL REQUIREMENTS TO THE DATABASES ON NATURAL CONDITIONS IN THE TRANSIT NAVIGATION REGIONS

12.1 Features of the information used in the databases on the environmental state

The main features of the data considered above are their large non-uniformity, spatial-temporal heterogeneity of coverage, multiple measurement methods, a large volume of the accompanying information necessary to carry out the analysis.

Thus, to create the database on the ice cover thickness multiyear measurements at polar stations along the Arctic coast, specialized observations of research expeditions, shipborne observations, etc. are used, with the direct and remote sensing methods (thickness gauges, mounted on aircraft, submarine sonars). Depending on the conditions and methods of observations the thickness data are accompanied by the corresponding information: snow depth, ice age categories, description of the ice cover morphometry in the measurement region, features of the methods affecting the observation accuracy.

In some cases the natural element requires a set of formal characteristics for its description. For example, when describing the system of the breakups in the ice cover the following generalized characteristics are used: a specific length (measure density), orientation distribution, modal orientation, modal interval occurrence frequency, resulting direction, the measure of the direction scattering, degree of orientation, distribution of the distances between the breakups at various directions of the sections.

12.2 Requirements to the structure of the databases

The accumulated experience of the information procession allows one to formulate the main requirements to the databases created:

- a possibility to combine in one base the information on various characteristics, assessed by different methods over a large time interval in various regions of the Arctic Ocean, as well as the information on the methods of data collection and their accuracy;
- a poss ibility for a convenient and logically simple formalization of the various initial information;
- a possibility to merge the information, obtained by different means with a different accuracy and details;
- a possibility of a spatial-temporal data interpolation;
- a possibility of a rapid data sorting and division into gro ups by any combination of features (by the values of characteristics, by the data collection methods, by space and time);
- a possibility to expand the database by adding new structural branches or by using the information from the other databases;
- a possibility to use standard and specially cre ated software means for the data analysis and presentation;

saving of memory used for the information storage at a sufficiently immediate access memory.

Below, as an example, the structure is described, which provides in an optimum way the fulfilment of the enumerated requirements.

All available information is divided into four groups (the links between the separate groups and inside each group are determined):

reference information;
survey characteristics (of a large measurement series);
characteristics of the part of the survey, linked to a point fixed in space;
measurement data.

The relationships between the groups are determined by the ratio ONE-to-MANY. Each survey (for example, ice thickness) has several fixed points, each of them being connected with one or several measurement points; each measurement point is related with several measurements, made at this point. Thus, each information group is located at its level, that is, the hierarhy approach to the data location is provided.

To provide the access to the data from TOP-to-BOTTOM and from BOTTOM-to-TOP each information group has an index. The indexing system provides a flexible access to data, a minimum excess (frequency) of information, simplicity of the data change and transformation. The indexing system allows one also to implement the relations of MANY-to-MANY.Such ratio relates all reference information, some survey characteristics, fixed points, measurement points, measurements.

A structure of this kind provides universal access to the information: a possibility of the choice of not only whole information groups, but of each separate characteristics from any group, too. The sampling can be made by any set of characteristics and values of these characteristics.

Such a structure appears to be open, i.e easy to expand. The information can be added inside each group (supplement to the "width" of the database). One can add new information groups at any hierarchy level (supplement to the "depth" of the database).

12.3 Choice and adaptation of the DBMS

As the Database Management System (DBMS) a standard software package PARADOX v.4.0, developed by the Borland company can be used.

PARADOX is considered a modern software meeting the requirements to the DBMS on natural conditions:

PARADOX is a system, in which the relational database is easely implemented;
PARADOX differs by simplicity as compared with other DBMS from the standpoint of the user;
to fulfil all functional DBMS it is not necessary to know the programming language ;
a high-performance of PARADOX is provided by the system of primary and secondary indices, the index system allowing one to expedite the work on a query and to provide direct access to data;

PARADOX 4.0 provides network and multitasking operation modes, new PARADOX versions are specially aimed at the network operation, the system of blocking allows for simultaneous data handling by several users;

data transmission to different external information media is provided by the availability of the PARADOX Engine in the DBMS, which can be used with the compilators Turbo C++, Borland C++, Turbo Pascal, etc. The PARADOX Engine provides a link between the data which are in the PARADOX and the software written in the high level language;

the relation with graphical packages is provided by the PARADOX package for Windows, which is included in the standard PARADOX set, which offers wide possibilities to use the graphical packages for an illustrative information presentation from the database.

An important feature of the DBMS is the presence of the package PARADOX SolLink, which provides access to the databases at SOL-server. The construction of the SOL-server allows one to organize a computer network by the client-server type. And the queries for packages of necessary data and their primary procession will be fulfilled at the server itself. Such organization will allow one to increase significantly DBMS performance. Also, the PARADOX DBMS provides reliable data protection. The system of passwords allows one to make private both some data and the information groups. There are several levels of data protection - from the prevertion of data modification to the prevertion of their scanning.

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APPENDIX 1

FINAL REVIEW
AND
COMMENTS FROM THE AUTHORS

National Research Council Canada
Conseil national de recherches Canada

Institute for Environmental Research and Technology
Institut de technologie et de recherche environnementales

Ottawa, Canada
K1A 0R6

NRC·CNRC

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Date : 17 July 1995 File/Dossier :

To/Destinataire : Elin Dragland
INSROP Secretariat
The Fridtjof Nansen Institute

Docufax : 011-47-6712 5047 Phone/Téléphone : 011-47-6733 8912

From/Expéditeur : R. Frederking

Docufax : (613) 954-1235 Phone/Téléphone :

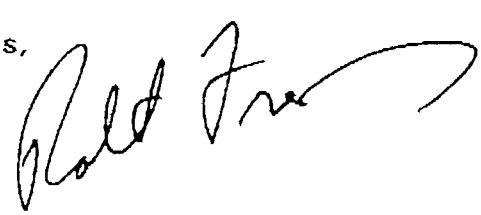
Page: 1 of 3

Re/Objet : Review of Project I.4.1

Attached please find my review of Project I.4.1 in the form of 10 June 1994 draft. The issues raised in my review may be addressed by modifications to the original report, or by an appendix which responds to the points raised. I note that Tsoy's letter of 19 October 1994, responds to most of my comments about Part 1.

I would also like to raise the issue of compatibility of various databases. INSROP should establish some guidelines for databases. Perhaps the Secretariat could make some recommendations to the Joint Research Committee.

Regards,



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Draft report for Project I.4.1 CONTENT OF DATABASE

reviewed by
R. Frederking, National Research Council of Canada

This report comprises three parts, the first addressing technical, operational and cost characteristics of existing and advanced icebreakers and icebreaking transport vessels of the Russian Arctic Fleet. The second part addresses the creation of an electronic catalogue of charts for use on the Northern Sea Route and the third part outlines the contents of a database on environmental conditions affecting navigation on the Northern Sea Route.

As a general observation I would suggest that compatibility between the three databases of this report and other INSROP databases is an important requirement.

Sub-Project I.4.1.1 (Part 1) "Database of the technical, operating, and cost characteristics of the existing and advanced icebreaking vessels of the Russian Arctic Fleet."

The database contains very detailed information on the technical (form, plate, framing, propulsion, auxiliaries, etc) and operational (fuel consumption, stores capacity, cargo hold, navigation, communications, etc) characteristics of icebreakers and icebreaking cargo vessels of Russian (Soviet) Registry Class ULA, UL and L1. The statement of work also calls for cost characteristics, however information for basing cost characteristics (fuel consumption, crew size, cruising speed, etc) is distributed throughout the database table. The report would benefit from a discussion of cost characteristics.

The database contains vessels in three ice classes, however there are other ice classes in the Russian Registry Classification. How and/or why was it decided to limit the database to the three ice classes noted. A table listing the number of ULA, UL and L1 vessels included in the database would be a helpful addition to the report.

This part of the report should contain a brief section describing the minimum required hardware, DOS version, special software, etc needed to run the database.

...2

Sub-Project I.4.1.2 (Part 2) "Development of the base of cartography data in the form of an electronic catalogue of maps."

This is a database of a catalogue of maps, and does not actually contain any maps. The report gives an adequate description of the database and its contents. It is quite comprehensive, including over 600 charts of the Northern Sea route.

A set of explicit instructions for running the database starting with a listing of the *readme.doc* file and listing of all files on the diskette would be a helpful addition to the report.

Sub-Project I.4.1.3 (Part 3) "Outline of the existing database of shipping tracks and of natural conditions there over different NSR regions having regard to season."

This is a comprehensive report with clear writing and good organization. The reports starts off with a broad discussion of the marine environmental factors pertinent to shipping activities in the Russian Arctic and then follows with a more directed treatment of environmental factors on shipping routes along the Northern Sea Route. It contains a thorough description of AARI ice, meteorological and oceanographic data pertaining to navigation. It gives a clear explanation of the data, its completeness and the quantity. The tables present much information in very concise form.

Ice conditions vary with both space and time. Information on ice conditions is needed for both strategic and tactical decision making in navigation. Some form of statistical output of expected ice conditions are a requirement for navigation planning and subsequent economic studies. The database should be able to accommodate output in a form lending itself to statistical treatment.

REPLIES to the comments of
Dr. Frederking

1..Apparently the information submitted by CNIIMF is not the database, but represents the source data and the text description in format DBASE III (.db files) to be subsequently loaded into the database and does not contain programs for their off line use. We suppose that this database is being developed within GIS (ARCInfo), where just all the necessary inquiries, reports and forms will be provided.

2. In the case of necessity and if appropriate financing is available CNIIMF is ready to undertake the development for INSROP of a special database for ice ships in a form to be used on PC, using Windows.

3. In sub-project 1.4.1.1 the ships are represented only with ice classes which are admitted for navigation along the NSR in conformity with the Rules of the Russian Marine Register of Shipping (MRS) and the Rules of navigation along the Northern Sea Route developed by the NSRA. According to the requirements of these Rules the operation of ice ships with an ice class not lower than L1 is allowed in the Arctic (and only in the summer period). During extended periods of summer navigation and in winter only the ships of the highest ice classes - UL and ULA - can sail along the NSR. 4. Number of ships included in the database:

class ULA - 31, class UL - 108, class L1 - 269.

5. Minimum required hardware and software to run the database: - IBM PC type personal computer with a base memory size of at least 640 KB;
MS-DOS operating system, version 3.3 and higher.
availability of 4 MB free space on a hard disk,
database is arranged in files of the debase III PLUS structure.

L. Tsoy, Yu. Glebko

2. Electronic catalogue of charts.

First of all I would like to thank Dr. Frederking for reviewing our report, I am sorry that he had to do this twice.

Now the situation in the charts supplement to the NSR is just different than it was in 1993. We have reflected all the changes in the created database, which is updated every 3 months.

INSROP participants are welcome to request this data free, in the form of database they prefer or in hard copy. Now about 180 Russian charts for the NSR are available for international use.

For more detailed information on cartographic supply, see section Route planning of Operational Aspects of Sub-Programme I, 1994 Report.

V. Vasilyev

APPENDIX 2

PRELIMINARY REVIEWS AND OTHER COMMENTS TO THE DELIVERABLES FROM PROJECT I.4.1

Required modifications to include the databases from Project I.4.1 into the INSROP GIS.

By Stig Magnar Løvås, SINTEF NHL.

This document comprises the outcome of Task 1 in the Joint Project Plan for Projects I.3.1 and I.3.4.

Section I.4.1.1: Ship-information database

This database shall contain data on technical, operational and cost characteristics as well as on ice properties of domestic arctic navigation cargo ships being assigned ice strengthening categories ULA, UL and L1 in the class symbols of the Russian Sea Register.

Project I.4.1 has implemented the database in dBase III+. The database comprises the following files:

so1.dbf, so2.dbf, so2L.dbf, so3.dbf, so4.dbf, so5.dbf, so6.dbf, so7.dbf,
fir.dbf, gru.dbf,
sl1.dbf, sl2.dbf, sl3.dbf, sl4.dbf, sl5.dbf, sl6.dbf, sl7.dbf, sl8.dbf, sl9.dbf, sl10.dbf, sl11.dbf, sl12.dbf, sl13.dbf, sl14.dbf, sl15.dbf, sl16.dbf, sl17.dbf

In addition to these files, two executable programs were included: dbu.exe and dbview.exe. These programs enable study of the dBase files, but the programs are not stable. During testing, **dbview**, always lost the DOS echo upon exit (F10), while **dbu** several times caused the PC to reboot.

Importing files from dBase (III and IV) is supported by ArcView 2.0, and all files were imported without error messages. The contents of the files were however partly meaningless. The reason is that Russian text in cyrillic characters is not supported. The following work is required to enable use of the ship-information database in the INSROP GIS:

1: The INSROP language is English, and all Russian text must therefore be translated or transcribed to English. For columns where it is important to use Russian (e.g. Original ship name) cyrillic characters must be transcribed to ASCII characters.

2: Database columns where the column 'values' are not self-explanatory should be described in an ASCII text file supplied with the database files. The information in this file should be suitable for inclusion in the INSROP GIS help files.

Section I.4.1.2: Electronic catalogue of sea charts

This database shall contain an electronic catalogue of sea charts to be used along the NSR.

Project I.4.1 has implemented the database in PARADOX, and has produced a run-time version of the catalogue. This run-time version only includes one example map, and during testing on a PC-486, the software caused the PC to reboot several times. Hence, the run-time version is not considered stable in the present form.

The electronic sea chart catalogue is considered suitable for inclusion in the INSROP GIS. As the database comprise both spatial and tabular information, this will enable e.g. the following queries to be handled:

1) Which NSR areas are covered by internationally available sea charts?
2) Which sea charts covers a given (e.g. planned) sailing?
3) Which sea charts are available within a given area?
4) Which sea charts of a given scale (or better) are available?
5) Which electronic sea charts are available and in what digital form are they?

Query 1 involves just a display of the outlines of all sea charts in the database.

Query 2 involves a spatial selection based on intersecting a specification of waypoints along a sailing route with the sea chart layer.

Query 3 involves a spatial selection based on intersecting a given area with the sea chart layer.

Query 4 involves a tabular selection based on a specification of requested map scale and whether only maps with this scale is requested or maps with smaller or larger scales also are of interest.

Query 5 involves a tabular based on an additional field in the database. This field should comprise the status of the sea chart, and the following alternatives are recommended:

- H Paper hard-copy only
- R Rasterized map (by scanning)
- V Vectorized map
- E ECDIS-compatible map
- N Not available yet, but planned for opening for international use

These example queries can also be combined to form more complex queries.

The following work is required to enable use of the sea chart database in the INSROP GIS:

1: ArcView cannot include PARADOX files directly. By exporting PARADOX files as **Delimited text-files**, using **Tabs** as field separators, **Quotes** to delimited text fields, and the **ANSI** character set, the PARADOX files should be ready for importing into ArcView. This description is valid for PARADOX for Windows, Version 1.0. As these delimited text files are ASCII files, they can also be transferred as is via electronic mail, while the PARADOX files needs special treatment by both the transmitter and the receiver to be transferred via e-mail.

2: The proposed field containing status of each sea chart should be added to the present design of the sea chart catalogue.

3: A small program (i.e. FORTRAN program) must be developed to extract from the delimited text files described in Item 1, the latitude-longitude positions (in WGS84 projection) of the sea chart corners. These latitude-longitude positions must be written to an ASCII file using the ARC/INFO generate format for polygons (refer Appendix A (Section A.7) in the Final Report from 1993-INSROP Project I.3.1 (Løvås, S.M. and Smith.C)

FAX TRANSMISSION SHEET
CENTRAL MARINE RÉSEARCH & DESIGN INSTITUTE Ltd.
CNIIMF

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia — The Fridtjof Nansen Institute, Norway — Ship & Ocean Foundation, Japan

Attention: Dr. E. Dragland
INSROP Secretariat, FNI
Reference: your fax of 12 September

FAX Number: (47)-67125047
No. of pages: 1
From: CNIIMF
Date: September 20, 1994

Dear Dr. Dragland!

Here is my comment to :

"Required modifications to include the databases from Project I.4.1 into the INSROP GIS."

Section I.4.1.1

1. "During testing, **dbview** always lost the DOS echo upon exi (F10), while **dbu** several times caused PC to reboot."

Dbview is well known utility from "Norton Commander" (2.0 and higher) by Semantec Corp., used all over the world. **Dbu** is also well known and used utility, which is also included as freeware in "Clipper" software set (executable module and source text, as far as I remember).

I think that something is wrong in software configuration on the computer, where programms were tested.

Concerning work required to enable the database in the INSROP GIS, items 1 and 2 would be fulfilled in the nearest future and we shall send to you the corrected database and required ASCII files.

Proposal: sometimes it would be necessary to use cyrillic characters. There is no problem for Windows 3.1 or other versions to support cyrillic characters by adding some cyrillic-latin fonts, required software can be supplied by us. All other Windows software (e.g. ArcView 2.0) then would support cyrillic characters also.

Section I.4.1.2

The run-time version proposed was tested on several computers and they never reboot. Maybe also something is wrong in configuration, and maybe there is internal memory or IRQ conflict, occurred while using some TSR or other software (specific for Norway?).

Concerning the work required to enable the use of the sea chart database:

1. We can export Paradox files to Dbase files. ArcView supports import of this files.
2. We can add proposed field, but we do not think that it would be useful, the cart can be V - vectorized, ECDIS - compatible and N - not available simultaneously. All that can be included in the "Name" field as a letter after special separator.
3. Required data can be obtained through Paradox script, run-time script, and exe - programm. That would be done in the nearest future.

General comment:

We have not received the Review by Dr. R. Frederking, but only the task which is not in the framework of the work and has no signature. Project 1.4.1 is a stand-alone project, but not the part of GIS. If the GIS is powerful and well-designed, there would be no problems to include regular information in popular databases formats.

Nevertheless, all the requirements would be fulfilled as asked by Norwegian party (within one month).

Doctor L.Tsoy agrees with my comments and proposes to create a working group, (or something like this) of persons involved in databases proceeding and other computer works for detailed internal cooperation.

V. Vasilyev, researcher

National Research Council Canada | Conseil national de recherches Canada

Institute for Environmental Research and Technology | Institut de technologie et de recherche environnementales

Ottawa, Canada
K1A 0R6

Thermal Technology Program | Programme de technologie thermique

NRC·CNRC

DOCUFAX

Date : 22 September 1994 File/Dossier :

To/Destinataire : Henning Simonsen
INSROP Secretariat
The Fridtjof Nansen Institute

Docufax : 011-47-67-125 047 Phone/Téléphone :

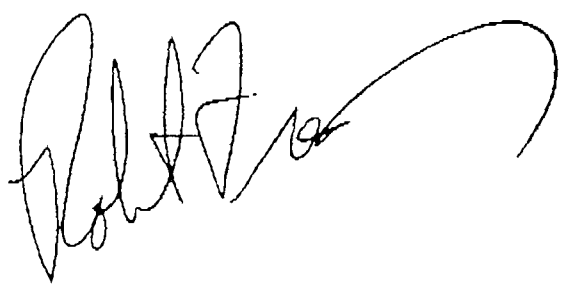
From/Expéditeur : R. Frederking

Docufax : (613) 954-1235 Phone/Téléphone :

Page: 1 of 2

Re/Objet : INSROP

Attached please find my review of Project I.4.1.



REVIEW OF PRELIMINARY REPORT ON PROJECT 1.4.1

In general I support the observations of the other reviewer of the report. Additionally I offer:

Section 1.4.1.1

Describes the organization of the database, but does not say how many vessels it contains. A table with the number of ULA, UL and L1 vessels in the database would be a helpful addition.

Section 1.4.1.2

No additional comments.

Part III

This is a "real" report, AARI authors are to be congratulated. As the reviewer points out there are areas for improvement, but there is something to improve.

p. 10 top comments of other reviewer; The three groups of data are described in the 3 following paragraphs of the report) pp. 10-12. The question concerning group 2, "data sets" and whether they can be read under DOS is valid. Group 3, "databases" and software run under DOS 4.0 (see bottom of p. 12 in report).

Chapters 3-8 contain a very tantalizing exposition of ice data available for the Russian Arctic from AARI.

Chapter 12 only presents a description of the ice information in the databases and some possibilities, but no real suggestions on how it could be used for ship routing.

I am still struggling with the database programs. i have gotten to the pint where Lovas got. Being able to run the programs, but having software problems. My experience is as follows:

Sub-project I.4.1.2 With the assistance of our network manager I was able to get the program to run. While scrolling around the database I had my keyboard locked up on more than one occasion. We transferred the program to another PC and the same problem occurred.

Sub-project I.4.1.2 All I can find on the database for this sub-project is a sample map in electronic format. All functions on the menu with the map are not yet functional. I can find no database cataloguing charts, which I understood to be the primary aim of this sub-project. Also explicit instructions to run the program are required.

Could you please get a response from the authors of the reports to these and my previous review sent on Oct 10.

Regards,

Bob Frederking

12.10.94.

National Research Council Canada
Conseil national de recherches Canada

Institute for Environmental Research and Technology
Institut de technologie et de recherche environnementales

Ottawa, Canada
K1A 0R6

Thermal Technology Program
Programme de technologie thermique

NRC·CNRC

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Date : 10 October 1994 File/Dossier :

To/Destinataire : Elin Dragland
INSROP Secretariat
The Fridtjof Nansen Institute

Docufax : 011-47-67-125 047 Phone/Téléphone : 011-47-6733 8912

From/Expéditeur : R. Frederking

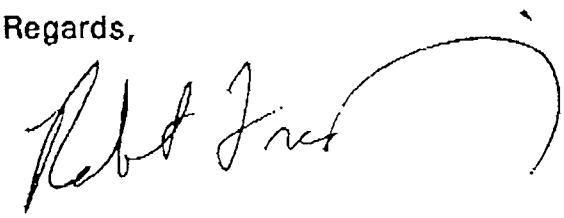
Docufax : (613) 954-1235 Phone/Téléphone :

Page: 1 of 3

Re/Objet : Review of Project I.4.1

Attached please find my review of Project I.4.1. I will see if I can communicate with Løvås tomorrow to establish that the databases for tasks .1 and .2 actually run.

Regards,



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Canada

Draft report for Project I.4.1 CONTENT OF DATABASE

reviewed by
R. Frederking, National Research Council of Canada

I have received the following documents:

1) Draft Report for Sub-projects .1, .2, and .3 of Project I.4.1 and comments of Stig Magnar Løvås sent to me in early August.

2) Communication to Baskin, Tsoy and Brestkin of Sept. 12 and their reply of Sept. 20, 3 diskettes, and your letter of Sept. 22.

and have reviewed them in relation to the requirements of Project I.4.1 identified in the three tasks in the scope of work for 1993.

As a general observation I would suggest that compatibility between the three databases of this report and other INSROP databases is an important requirement.

Sub-Project I.4.1.1 "Database of the technical, operating, and cost characteristics of the existing and advanced icebreaking vessels of the Russian Arctic Fleet."

The database contains very detailed information on the technical (form, plate, framing, propulsion, auxiliaries, etc) and operational (fuel consumption, stores capacity, cargo hold, navigation, communications, etc) characteristics of icebreakers and icebreaking cargo vessels of Russian (Soviet) Registry Class ULA, UL and L1. The statement of work also calls for cost characteristics, however information for basing cost characteristics (fuel consumption, crew size, cruising speed, etc) is scattered throughout the database table. Is it beyond the scope of this study to explore the cost characteristics? The report would benefit from a discussions of this factor.

The database contains vessels in three ice classes. I believe there are other ice classes in the Russian Registry Classification. How and/or why was it decided to limit the database to the three ice classes noted. A naval architect should be asked to review the table presented in the report to ensure standard english terminology is used. I have made some corrections to the table.

I have not been able to get the database to run. I am not a DOS or database expert, so the difficulties may be of my own making. In general the report could be more informative as to the operation and content of the database. The minimum required hardware, DOS version, and special software, etc should be stated in the report. A table listing the number of ULA, UL and L1 vessels included in the database would be a helpful addition.

Sub-Project I.4.1.2 "Development of the base of cartography data in the form of an electronic catalogue of maps."

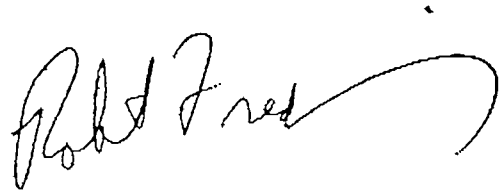
This is to be a database of a catalogue of maps, and is not to actually contain any maps as I understand the work statement. The report would appear to contain an adequate description of the database and its contents. Again I was unable to run the database. A set of explicit instructions for running the database starting with a listing of the *readme.doc* file and listing of all files on the diskette would be a helpful addition to the report. Also translations of the two forms on pages 2-4 and 2-5 should be added to the report.

Sub-Project I.4.1.3 "Outline of the existing database of shipping tracks and of natural conditions there over different NSR regions having regard to season."

This is a professional report with clear writing and good organization. It was a pleasure to read. It contains an exhaustive description of AARI ice, meteorological and oceanographic data pertaining to navigation through the Northern Sea Route. It gives a clear explanation of the data, its completeness and the quantity. The tables present much information in very concise form. Using slightly larger type in Table 2 would improve readability.

One aspect which appears to be missing from the report is a consideration of actual shipping tracks. There is only a brief mention of this topic (pages 34-35). I would have thought some presentation of historical information of ship type, ice conditions and speed made good along selected tracks would also be a part of the content of the database.

Ice conditions vary with both space and time. Information on ice conditions is needed for both strategic and tactical decision making in navigation. Some form of statistical output of expected ice conditions are a requirement for navigation planning and subsequent economic studies. The database should be able to accommodate output in a form lending itself to statistical treatment. The actual form of the database will have to be decided in relation to requirements of other INSROP projects.



CENTRAL MARINE RESEARCH
& DESIGN INSTITUTE Ltd.
CNIIMF

Elin Dragland
Programme Secretary,
Fridtjof Nansen Institute,
N-1324 Lysaker, Norway
FAX: (47) 6712 5047

C42- 103 19.10.94

Re: Review of report from Project I.4.I: Content of Database.
Sub-Project I.4.I.I "Database of the technical, operating and cost characteristics of the existing icebreaking vessels of Russian Arctic Fleet".

We have looked through the comments of Dr.R.Frederiking and Mr.S.M.Lovas. As far as information data on Russian ships of arctic navigation are concerned we consider it necessary to state the following:

I. Apparently the information submitted by CNIIMF is not the database, but represents the source data and the text description in format DBASE III (.dbf files) to be subsequently loaded into the database and does not contain programs for their offline use. We suppose that this database is being developed within GIS (ARCInfo), where just all the necessary inquiries, reports and forms will be provided.

2. In the case of necessity and if appropriate financing is available CNIIMF is ready to undertake the development for INSROP of a special database for ice ships in a form to be used in PC, in the Window medium.

3. In sub-project I.4.I.I the ships are represented only with ice classes which are admitted for navigation along the NSR in conformity with the Rules of the Russian Marine Register of Shipping (MRS) and Rules of navigation along the Northern Sea Route developed by the NSRA. According to the requirements of

HEAD OFFICE:
Ul. Kavalergardskaya, 6, CNIIMF
193015 St. Petersburg, Russia
Tel.: (812) 271-12-83, 275-69-57
Telex: 121458 CNIIMF Russia
Fax: (812) 274-38-64 CNIIMF

OFFICE:
Ul. Stavropolskaya, 10, CNIIMF
193124, St. Petersburg, Russia
Tel.: (812) 274-63-63, 271-10-32
Telex: 121558 CNIIMF Russia
Fax: (812) 274-47-12 CNIIMF

BANK ACCOUNT:
37070801295 in Industrial and Construction Bank of St. Petersburg via Correspondent Account of Industrial and Construction Bank in Kansallis-Osake-Pank, USD No 312-USD-9019 SUPB

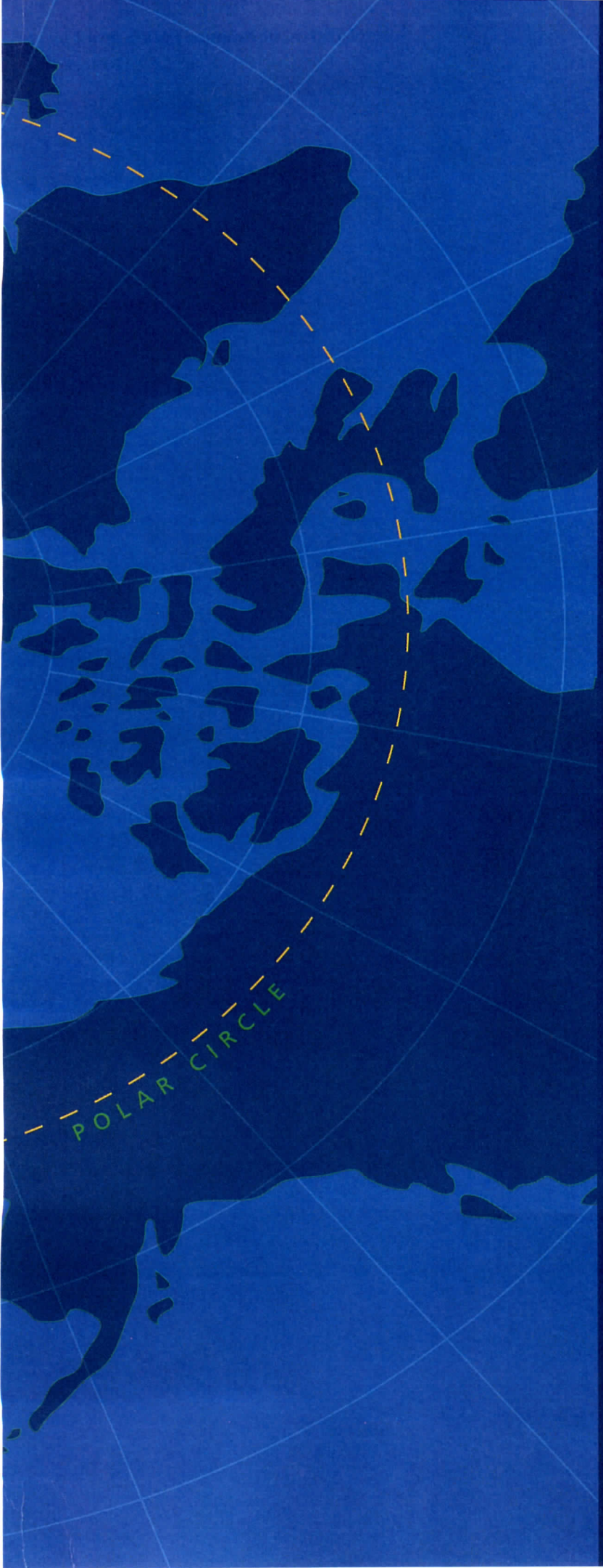
these Rules the operation of ice ships with an ice class not lower than LI is allowed in the Arctic (and only in the summer period). During extended periods of summer navigation and in winter only the ships of the highest ice classes - UL and ULA- can sail along the NSR.

Please be so kind as transmitting our explanations to Dr.R.Frederiking and Mr.S.M.Lovas.

Sincerely yours

L.Tsoy

Head of LLT



The three main cooperating institutions of INSROP

Ship & Ocean Foundation (SOF), Tokyo, Japan.

SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Sasakawa Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.

Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.

CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stock-holding company.

The Fridtjof Nansen Institute (FNI), Lysaker, Norway.

FNI was founded in 1958 and is based at Polhøgda, the home of Fridtjof Nansen, famous Norwegian polar explorer, scientist, humanist and statesman. The institute spesializes in applied social science research, with special focus on international resource and environmental management. In addition to INSROP, the research is organized in six integrated programmes. Typical of FNI research is a multi-disciplinary approach, entailing extensive cooperation with other research institutions both at home and abroad. The INSROP Secretariat is located at FNI.