ATTACHMENT

DEFINITION OF FM 94 BUFR USING BACKUS-NAUR FORM

1. INTRODUCTION

The *Backus-Naur Form* (BNF) is a powerful and unambiguous means of defining a representation form. The notation used is as follows:

⟨lower case letters⟩	an entity defined to be comprised of other entities
⟨UPPER CASE LETTERS⟩	an "atomic" or "terminal" entity, *not* defined in terms of other entities
: : =	is comprised of
⟨entity⟩	specific occurrence of an entity
⟨entity 1⟩⟨entity 2⟩	entity 1 followed by entity 2
⟨- - -⟩|⟨- - -⟩	alternative entities
⟨- - -⟩(n)	exactly n occurrences
⟨- - -⟩o	optional entity (zero or one)
⟨- - -⟩*	zero or more occurrences
⟨- - -⟩+	one or more occurrences

2. DEFINITION OF FM 94 BUFR

In the following, BNF is used to define BUFR from a "top down" approach.

2.1 BUFR message

⟨BUFR message⟩	: : =	⟨indicator section⟩ ⟨identification section⟩ ⟨optional section⟩o ⟨data description section⟩ ⟨data section⟩ ⟨END OF BUFR MESSAGE⟩
⟨END OF BUFR MESSAGE⟩	: : =	string "7777"

2.2 Indicator section

⟨indicator section⟩	: : =	⟨START OF BUFR MESSAGE⟩ ⟨total length of BUFR message⟩ ⟨BUFR edition number⟩
⟨START OF BUFR MESSAGE⟩	: : =	string "BUFR"
⟨total length of BUFR message⟩	: : =	24-bit unsigned integer giving the total length of the message, including the Indicator section, in octets
⟨BUFR edition number⟩	: : =	8-bit unsigned integer

2.3 Identification section

⟨identification section⟩ : : = ⟨LENGTH OF SECTION⟩
⟨BUFR MASTER TABLE⟩
⟨originating centre number⟩
⟨UPDATE SEQUENCE NUMBER⟩
⟨OPTIONAL SECTION FLAG⟩
⟨RESERVED FLAG⟩ (7)
⟨BUFR DATA CATEGORY⟩
⟨BUFR DATA SUB-CATEGORY⟩
⟨version number of master table used⟩
⟨version number of local tables used⟩
⟨YEAR OF CENTURY⟩
⟨MONTH⟩
⟨DAY⟩
⟨HOUR⟩
⟨MINUTE⟩
⟨optional part⟩
⟨PADDING⟩*

⟨LENGTH OF SECTION⟩ : : = 24-bit unsigned integer giving the length of the section in octets

⟨BUFR MASTER TABLE⟩ : : = 8-bit unsigned integer giving the BUFR master table

⟨originating centre number⟩ : : = 16-bit code table

⟨UPDATE SEQUENCE NUMBER⟩ : : = 8-bit unsigned integer assigned by the originating centre as zero when a BUFR message is first created, and incremented each time it is updated

⟨OPTIONAL SECTION FLAG⟩ : : = 1-bit flag – 1 indicates Optional section; 0 that it is not present

⟨RESERVED FLAG⟩ : : = 7-bit flag – reserved for future use (set to 0)

⟨BUFR DATA CATEGORY⟩ : : = 8-bit unsigned integer indicating the general BUFR data category according to Table A

⟨BUFR DATA SUB-CATEGORY⟩ : : = 8-bit unsigned integer indicating the BUFR data sub-category according to local convention

⟨version number of master table used⟩ : : = 8-bit unsigned integer

⟨version number of local tables used⟩ : : = 8-bit unsigned integer

⟨YEAR OF CENTURY⟩ : : = 8-bit unsigned integer – year
⟨MONTH⟩ : : = 8-bit unsigned integer – month
⟨DAY⟩ : : = 8-bit unsigned integer – day
⟨HOUR⟩ : : = 8-bit unsigned integer – hour
⟨MINUTE⟩ : : = 8-bit unsigned integer – minute
} most typical for the BUFR message contents

⟨optional part⟩ : : = as defined by local convention

⟨PADDING⟩ : : = sufficient binary zeros, if required, to ensure the section length is a multiple of 2 octets

2.4 Optional section

⟨optional section⟩ : : = ⟨LENGTH OF SECTION⟩
⟨RESERVED OCTET⟩
⟨entity for local use by ADP centres⟩
⟨PADDING⟩*

⟨RESERVED OCTET⟩ : : = 8-bit unsigned integer set to 0

⟨entity for local use by ADP centres⟩ : : = defined by ADP centre concerned

2.5 Data description section

⟨data description section⟩ : : = ⟨LENGTH OF SECTION⟩
⟨RESERVED OCTET⟩
⟨NUMBER OF DATA SUBSETS⟩
⟨description section flags⟩
⟨subset data description⟩

⟨NUMBER OF DATA SUBSETS⟩ : : = 16-bit unsigned integer indicating the number of subsets of data contained in the BUFR message

⟨description section flags⟩ : : = ⟨OBSERVED DATA FLAG⟩
⟨COMPRESSED DATA FLAG⟩
⟨RESERVED FLAG⟩ (6)

⟨OBSERVED DATA FLAG⟩ : : = 1-bit flag – 1 indicates observed data; 0 indicates other data

⟨COMPRESSED DATA FLAG⟩ : : = 1-bit flag – 1 indicates compressed data; 0 indicates non-compressed data

⟨RESERVED FLAG⟩ : : = 6-bit flag – reserved for future use (set to 0)

⟨subset data description⟩ : : = ⟨descriptor⟩+

⟨descriptor⟩ : : = ⟨element descriptor⟩|
⟨replication descriptor⟩|
⟨operator descriptor⟩|
⟨sequence descriptor⟩

⟨element descriptor⟩ : : = ⟨table b reference⟩

⟨replication descriptor⟩ : : = ⟨DESCRIPTOR CODE⟩
⟨REPLICATION SCOPE⟩
⟨NUMBER OF REPLICATIONS⟩
⟨table b reference⟩ o

⟨DESCRIPTOR CODE⟩ : : = 2-bit unsigned integer defining the descriptor type – value 1

⟨REPLICATION SCOPE⟩ : : = 6-bit unsigned integer defining the number of subsequent descriptors to be replicated

⟨NUMBER OF REPLICATIONS⟩ : : = 8-bit unsigned integer defining the number of times the descriptors within the scope are to be replicated – if 0, the next element descriptor relates to a data item containing the number of replications

⟨operator descriptor⟩ : : = ⟨table c reference⟩

⟨data description operator⟩ : : = ⟨replication descriptor⟩|
⟨replication descriptor⟩
⟨element descriptor⟩|
⟨operator descriptor⟩|
⟨operator descriptor⟩
⟨element descriptor⟩

⟨sequence descriptor⟩ : : = ⟨table d reference⟩

2.6 BUFR Table B

⟨table b⟩ : : = ⟨table b entry⟩+

⟨table b entry⟩ : : = ⟨table b reference⟩
⟨ELEMENT NAME⟩
⟨UNITS NAME⟩
⟨UNITS SCALE SIGN⟩
⟨UNITS SCALE⟩
⟨UNITS REFERENCE SIGN⟩
⟨UNITS REFERENCE VALUE⟩
⟨ELEMENT DATA WIDTH⟩

⟨table b reference⟩ : : = ⟨DESCRIPTOR CODE⟩
⟨CLASS NUMBER⟩
⟨ELEMENT NUMBER⟩

⟨DESCRIPTOR CODE⟩ : : = 2-bit unsigned integer – value 0

⟨CLASS NUMBER⟩ : : = 6-bit unsigned integer – indicating table b class

⟨ELEMENT NUMBER⟩ : : = 8-bit unsigned integer – indicating table b element

⟨ELEMENT NAME⟩ : : = ⟨first line of element name⟩
⟨second line of element name⟩

⟨first line of element name⟩ : : = first 32 characters of element name

⟨second line of element name⟩ : : = next 32 characters of element name

⟨UNITS NAME⟩ : : = 24-character name of SI units used: entered as “CODE TABLE” if data values reference to a code; as “FLAG TABLE” if values reference to a flag; as “NUMERIC” if values are non-dimensional; as “CCITT IA5” if values are characters

⟨UNITS SCALE SIGN⟩ : : = 1-bit sign of units scale value (0 = positive)

⟨UNITS SCALE⟩ : : = 7-bit unsigned integer giving the power of 10 by which the original data element in the units given by ⟨UNITS NAME⟩ is to be multiplied to give the value found in the BUFR message

⟨UNITS REFERENCE SIGN⟩ : : = 1-bit sign of units reference value (0 = positive)

⟨UNITS REFERENCE VALUE⟩ : : = 31-bit unsigned integer containing the data element reference value, scaled according to the units scale

⟨ELEMENT DATA WIDTH⟩ : : = 8-bit unsigned integer indicating data width in bits

2.7 BUFR Table C

⟨table c⟩ : : = ⟨table c entry⟩+

⟨table c entry⟩ : : = ⟨table c reference⟩
⟨OPERAND⟩
⟨OPERATOR NAME⟩
⟨OPERATION DEFINITION⟩

⟨table c reference⟩ : : = ⟨DESCRIPTOR CODE⟩
⟨OPERATION CODE⟩

⟨DESCRIPTOR CODE⟩ : : = 2-bit unsigned integer – value 2

⟨OPERATION CODE⟩ : : = 6-bit unsigned integer indicating the intended operation

⟨OPERAND⟩ : : = 8-bit unsigned integer value, to be used as an operand as indicated by the operation definition

⟨OPERATOR NAME⟩ : : = 40-character operator name

⟨OPERATION DEFINITION⟩ : : = rules defining the operation to be performed

2.8 BUFR Table D

⟨table d⟩ : : = ⟨table d entry⟩+

⟨table d entry⟩ : : = ⟨table d reference⟩
⟨descriptor⟩ ⟨descriptor⟩+

⟨table d reference⟩ : : = ⟨DESCRIPTOR CODE⟩
⟨CATEGORY NUMBER⟩
⟨SEQUENCE NUMBER⟩

⟨DESCRIPTOR CODE⟩ : : = 2-bit unsigned integer – value 3

⟨CATEGORY NUMBER⟩ : : = 6-bit unsigned integer indicating table d category

⟨SEQUENCE NUMBER⟩ : : = 8-bit unsigned integer indicating table d sequence list

2.9 Data section

⟨data section⟩ : : = ⟨LENGTH OF SECTION⟩
⟨RESERVED OCTET⟩
⟨binary data as defined by sequence descriptors⟩
⟨PADDING⟩*

3. DEFINITION OF EXCHANGE FORMS FOR BUFR TABLES

3.1 Format for international exchange of Table B

⟨table b⟩ : : = ⟨table b entry⟩+

⟨table b entry⟩ : : = ⟨DESCRIPTOR FLAG⟩
⟨CLASS NUMBER⟩
⟨ELEMENT NUMBER⟩
⟨ELEMENT NAME LINE 1⟩
⟨ELEMENT NAME LINE 2⟩
⟨UNITS NAME⟩
⟨UNITS SCALE SIGN⟩
⟨UNITS SCALE⟩
⟨UNITS REFERENCE SIGN⟩
⟨UNITS REFERENCE VALUE⟩
⟨ELEMENT DATA WIDTH⟩

⟨DESCRIPTOR FLAG⟩ : : = 1-digit integer as 1 character

⟨CLASS NUMBER⟩ : : = 2-digit integer as 2 characters

⟨ELEMENT NUMBER⟩	: : =	3-digit integer as 3 characters
⟨ELEMENT NAME LINE 1⟩	: : =	Line 1 of name as 32 characters
⟨ELEMENT NAME LINE 2⟩	: : =	Line 2 of name as 32 characters
⟨UNITS NAME⟩	: : =	units in 24 characters, or "CODE TABLE", "FLAG TABLE", "NUMERIC" or "CCITT IA5"
⟨UNITS SCALE SIGN⟩	: : =	sign of units scale as 1 character
⟨UNITS SCALE⟩	: : =	3-digit unsigned integer as 3 characters giving the power of 10 by which the original data element in the units given by ⟨UNITS NAME⟩ is to be multiplied to give the value found in the BUFR message
⟨UNITS REFERENCE SIGN⟩	: : =	sign of units reference value as 1 character
⟨UNITS REFERENCE VALUE⟩	: : =	10-digit unsigned integer as 10 characters
⟨ELEMENT DATA WIDTH⟩	: : =	3-digit unsigned integer as 3 characters

Notes:

(1) All characters shall be represented as upper case characters using CCITT IA5 (International Alphabet No. 5).

(2) FORTRAN notation shall be used to represent units; thus $m^2\ s^{-2}$ will be represented as M**2/S**2, etc.

(3) Each table b entry shall be represented using 95 characters.

3.2 Format for international exchange of Table D

⟨Table d⟩	: : =	⟨Table d entry⟩+
⟨Table d entry⟩	: : =	⟨F DESCRIPTOR⟩ ⟨X DESCRIPTOR⟩ ⟨Y DESCRIPTOR⟩ ⟨SEQUENCE DESCRIPTOR⟩*
⟨F DESCRIPTOR⟩	: : =	1-digit integer F descriptor as 1 character
⟨X DESCRIPTOR⟩	: : =	2-digit integer X descriptor as 2 characters
⟨Y DESCRIPTOR⟩	: : =	3-digit integer Y descriptor as 3 characters
⟨SEQUENCE DESCRIPTOR⟩	: : =	6-digit integer table reference as 6 characters