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THE BOOSTER-MODEL DATABASE: PHASE I

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DISCLAIMER

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PHASE I

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THE "BOOSTER_MODEL" DATABASE

(with SPECIFICATIONS)

E. H. Auerbach

I. Introduction.

Since early 1990, we have been experimenting with at database for modelling the booster; we have created a number of relations, entered data into them, and used these data in connection with some modelling programs (notably, in studies of the Linac-to-Booster Line). Thus we have obtained some experience in determining our database needs. We are now in a position to specify explicitly a Booster-Model-Database, which though only an early version, has a reasonable probability of being the permanent nucleus of any future expansion.

In specifying the relations (for a glossary of database terms used, see Appendix A) needed, we have tried to distinguish the various data groups used in describing objects in the machine according to whether a description is a model description or is essentially a physical one; if physical, one divides data among relations according as how general or specific these descriptive data are. The geographical layout of the machine and its ancillary lines forms a separate relation.

This viewpoint may not be the one chosen if one has a particular application (say control or graphics) in mind; however, we believe it lends itself best for describing data that feeds modelling and model-based programs.

An enumeration of the relations and the reasoning supporting the particular divison we have chosen is given in the following section (II.-A); the manner in which these relations are used is discussed in II.-B. Detailed specifications for the fields of these relations are given in Section III. A discussion of possible future expansions is the subject of Section IV. Appendices B, C and D list the objects in the Booster, the LTB- and BTA-lines that define the contents of this database.

II. A. Relations in the "Booster_Model" Database.

The primary description of a ring (such as the Booster) or of a beam line is made by specifying the layout of the lattice: enumerating what lattice elements and instruments form the "machine" being defined. As a result, our first relations specify geography (i.e., contains data fields which either are purely geographical) or else (2) describe the elements in such general terms as to allow us to enter other relations where the descriptive data are stored.

These two aspects give us the relations:

(1) element_layouts
(2) machine_elements

Let us now consider a particular element, say a magnet (or an instrument). We can describe that element from various viewpoints. There are data applicable to it beacuse that data pertains to all elements of the same design-type; there are model-data applicable because of the way a modeler (or the requirements of a modelling program) views that element; then there are data that apply to that particular instance of the design type. In terms of control (or variations in current in a magnet) some magnets are "tied together" and cannot be varied independently; this is specified by indicating which magnets are members of the same "string". Thus, for magnets, these several considerations give rise to the relations:

(3) magnet_properties
(4) magnet_prototypes
(5) magnet_models
(6) magnet_strings

Now, considering instruments, properties and prototypes are appropriate; but models are not necessary since what an instrument signifies in any modelling program is a location at which model data are to be computed or compared. We have found that the calibration data of the various instruments can not easily be forced into the same mold, so that it is simpler to have separate relations with different data fields for each specific instrument type rather than a single more general description like that for magnets of (3) and (4). Thus, for instruments we will have:

(7a) pues
(7b) strip_line_pms
(7c) harps
(7d) rad_mons

plus others, to be added as needed.

Finally, the results of the model programs produce model descriptions of the machine(s) in terms of Twiss parameters, distorted orbits, etc. This give rise to:

(8) machine_model_parameters

In addition, we will define two relations containing general physical data not related to particular machine elements: these include basic physical constants, the values of which should be used consistently throughout the various calculations (for example, serious conflicts can occur if for the velocity of light one uses 3x10^8 m/sec in one application and the more exact value -- 2/3rds of a part in a thousand less -- in another), and general machine parameters. The masses of heavy-ions, because of the structure of such a table, are placed in a separate relation. These define relations:

(9) physical_constants
(10) species_masses

Detailed specifications are given in Section III.

II. B. Using the Relations of the "Booster_Model" Database.

Though in due course we will wish to do, we will not at the present time be doing direct, real-time, model-based control. Consequently time scales involved in obtaining data from the database are such that for a given modeling application, it is sufficient to create a file (which will be read by the modeling program) which contains an extract of the data in a given relation that the modeller wishes to use, extracted according to set conditions limiting the data either to those immediately needed or to a slightly larger superset. Similarly, on completion of a modelling calculation (or a series of such calculations) when one has finally decided on the results which are to be stored in the database, the resulting file(s) can then be converted into entries (or as modifications of entries) in the database. The use of such intermediate files also obviates problems arising from use of non-contemporaneous data: during a non-real-time modelling session, which can last several hours, some of the data in the database may properly change; by doing a conversion to files at the beginning of the session, rather than requesting data at the moment it is first needed in a calculation, one is then working with a consistent data set.

A. Luccio has developed programs to perform these functions: these are called "relation_import" and "relation_export" and are described in a recent Tech. Note. [Booster Tech. Note No. 162]

III. Definitions of Relations in Database.

For each relation, we define its name followed by the definitions of the data-fields of the relation. At the end of each field definition is the format: integer, float, character (with number of characters); when there are a number of fields in sequence whose data are floating point numbers, the description: "float - all" follows the last one; the first field of each relation has a character format: "varying - 20" for compatibility with database tools that already exist. For fields with the notation: (#App.E), see Appendix E for a listing of possible entries.

(1) Relation "element_layouts"

machine_element_name	standard name (in Reece convention) e.g., BLI.QH5, BMM.DHF8 -- See Appendices B, C, D for examples. [varying - 20]
machine	ring or line name (#App.E) e. g., LTB, BTA, BOOSTER [varying - 12]
s_coord	longitudinal coordinate [in meters] of the center (along s) of the element as measured from the start of a line or a from a designated

s=0. for a ring
[float]

element_length — physical length in s-direction [in meters] (may be given as 0.)
[float]

section — section name in machine (#App.E)
e. g., for BOOSTER: A1 to F8,
for a line, distance in feet from start or section-number (if that line has numbered sections)
[varying - 4]

[the next six quantities give surveyed displacements from the design (nominal) location:]

x_offset	displacement in transverse x-direction [mm]
y_offset	displacement in transverse y-direction [mm]
s_offset	displacement in longitudinal s-direction [mm]
pitch	rotation about x-axis [mrad]
yaw	rotation about y-axis [mrad]
roll	rotation about s-axis [mrad]

[float - all]

(2) Relation "machine_elements"

machine_element_name — standard name (in Reece convention)
e.g., BLI.QH5, BMM.DHF8
[varying - 20]

machine_element_type — for magnets, this describes the generic magnet-type, e.g., dipole, quad
for instruments, the instrument-type e.g., strip_line_pm, pue (#App.E)
[varying - 20]

subsystem_name — e.g., magnets, instruments, etc.
[varying - 20] (#App.E)

serial_no — serial number of the actual magnet, instrument, etc. currently placed as this machine_element_name
[varying - 20]

control_device_name — control device to which this machine_element_name is attached. A string of magnets powered together will have the same control_device_name (note: when several elements attached to the same control device, independent control may not be possible.)
[varying - 20]

usable_flag — on/off signal -- off implies any one of hardware, calibration, mistrust by studies-people of reliablilty of this device ==> not useful for inclusion in correction algorithms (-- meaningful for correctors, instruments, etc. but useless for main magnets)
[varying - 4]

(3) Relation "magnet_properties"

serial_no	serial number of an actual magnet E.g., BMD-037, BMQL-021 -- the first part usually is the same as the prototype_name (next entry) [varying - 20]
prototype_name	name of the design-type for this magnet (see next relation) [varying - 20]
data_source	m = actually measured g = generic (from averages of the same prototype, actually measured) c = calculated for prototype [varying - 4]
magnetic_length	magnetic length (actual) [in meters]
theta_1	entrance (upstream face) angle [in rad]
theta_2	exit (downstream face) angle [in rad] [float - all]
magnet_model_name	identification of magnet_model used in modeling; blank if unique [see relation (5)] [varying - 20]
db0	) dipole
db1	) quadrupole
db2	)relative field errors: sextupole
db3	) octupole
db4	) decapole
db5	) dodecapole [float - all]

(4) Relation "magnet_prototypes"

prototype_name	magnets for lines follow the old AGS convention: e.g., 2D20, 4Q10; for the main ring, BMD, BMS, BMQ, BMQL, [varying - 20] BTQH, BTQV, BTQS, etc. are used.
magnet_class	e.g., dipole, quad, sext, etc. [varying - 8] (#App.E)
magnetic_length	magnetic length (design) [in meters]
physical_length	physical (overall) length [in meters]
core_length	core (lamination) length [in meters] [float - all]
apert_type	"ellp" or "rect" [varying - 4]
apert_x	) half-width (rect) or
apert_y	) semi-axis (ellp) [in mm]
gap_height	[in mm]
pole_width	[in mm]
pole_tip_radius	[in mm]
resistance	[in milli-ohms]
inductance	[in milli-henries] [float - all]
no_magnets	number of magnets of this prototype (including spares)

	[integer]
comments	field for short description of prototype or its use [text -- up to 60 characters]

(5) Relation "magnet_models"

magnet_model_name	if a given location has an independently controllable magnet, the "machine_element_name" appears here; otherwise, a name unique to the model-class appears here and in relation (3) [varying - 20]
momentum	if the model for a given magnet is momentum independent, this is 0. or blank; otherwise the appropriate momentum [in GeV/c] is given [float]
K0	bend angle [in rad]
K1	quadrupole-strength [in 1/m]
K2	sextupole-strength [in 1/m**2]
K3	octupole-strength [in 1/m**3]
K4	decapole-strength [in 1/m**4]
K5	dodecapole-strength [in 1/m**5] [float - all]

(6) Relation "magnet_strings"

control_device_name	name of string (unique to each magnet string) [varying - 20]
resistance	total resistance of string (magnets and cabling [in milli-ohms]
inductance	total inductance of string (magnets and cabling [in milli-henries]
max_current	maximum current permitted in powering this string [in amps]
max_voltage	maximum voltage permitted in circuit for this string [in volts]
vac_chamber_time_constant	)
iron_time_constant	) [in msec]
electrical_time_constant	) [float - all]
no_magnets	number of magnets in string [integer]
B_I_transfer_func_c	low momentum (constant part)
B_I_transfer_func_l	(lin.) momentum dependence (if any) [float - all]

(additional transfer function specifications, for example, as a function of B-dot, as required)

[The transfer functions can be described either by tables, by two parameters (where eseentially linear) or by multiple parameters (where well described by a linear mid-region, with exponential tails). The precise description depends on results from the magnet measurement program. Note that where differences over a magnet-type are small, a single transfer function for the string is appropriate and the deviations can be either ignored or covered by dB0-dB5 of the relation "magnet_properties".]

(7a,b,...) Relations for instruments --- in general, the relation name will be (or closely resemble) the name of the machine_element_type (see Relation (2)) for that instrument:
e.g., relation "harps"

```
serial_no                     serial number of actual instrument
                              (E.g., BPUE-18)
                              [varying - 20]
x0_elect              offset of electrical center from x=0. [mm]
y0_elect              offset of electrical center from y=0. [mm]
<calibration constants>   --  defined specfically for each
                                instrument type
                              [float - all]
      (as many as are necessary)
```

(8) Relation "machine_model_parameters"

```
machine_element_name     standard name (in Reece convention)
                             e.g., BLI.QH5,  BMM.DHF8
                             [varying - 20]
operating_regime         {text or momentum value} unique identi-
                             fier supplied by modeler to dis-
                             tinguish different conditions giv-
                             ing rise to these calculated values
                             [varying - 20]
s_coord_up               upstream s-coordinate [in meters] at
                           which these parameters apply
s_coord_dn               downstream s-coordinate [in meters] at
                           which these parameters apply
                           (for "0-length devices this value
                           will be 0. and only one set of
                           Twiss parameters are included).
                           [note for magnets, these are a
                            mag_length apart]
beta_x_up                )
beta_y_up                )
alfa_x_up                )
alfa_y_up                ) upstream Twiss parameters
eta_x_up                 )      [betas, etas in meters;
eta_y_up                 )        mus in rad/(2*pi)]
mu_x_up                  )
mu_y_up                  )
x_c_up                    }
y_c_up                    } upstream distorted orbit values
xpr_c_up                  }         [in mm and mrad]
ypr_c_up                  }
```

```
beta_x_dn                  )
beta_y_dn                  )
alfa_x_dn                  )
alfa_y_dn                  ) downstream Twiss parameters
eta_x_dn                   )       [betas, etas in meters;
eta_y_dn                   )         mus in rad/(2*pi)]
mu_x_dn                    )
mu_y_dn                    )
x_c_dn                      }
y_c_dn                      } downstream distorted orbit values
xpr_c_dn                    }         [in mm and mrad]
ypr_c_dn                    }
                               [float - all]
```

(9) Relation "physical_constants"

```
symbol                     symbolic representation of physical
                              constant  E.g., "c", "m(p)"
                              [varying - 20]
constant                   value of constant
                              [float - double]
units                      physical units in which value is
                              expressed  E.g., "m/sec", "GeV"
                              [varying - 12]
description                short text
                              [text - 24]
```

(10) Relation "species_ masses"

```
symbol                     symbolic representation for element
                              E.g., "He", "Au"
                              [varying - 20   (only 2 used)]
Z                          atomic number of element
                              [integer]
A_min                      minimum atomic mass in table
                              [integer]
A_max                      maximum atomic mass in table
                              [integer]
mass_1                     )
mass_2                     )  mass [in GeV/c^2] of species
mass_3                     )    for A_min, A_min + 1, ...,
mass_4                     )        (at most) A_min + 7
mass_5                     )    (entries corresponding to
mass_6                     )      unstable species should be
mass_7                     )      missing or 0.)
mass_8                     )
                              [float - all]
```

Examples:

We show as an example, in Appendix F, the contents of the relation for "magnet_prototypes" [no. (4)] with only the major magnets for LTB, BOOSTER and BTA included, Additional Comments:

Relation (3):
Additional quantities, based on the measurement program for Booster Main Magnets (Dipoles, Quads, Sextupoles) will be added on consultation with Ed. Bleser. Only summary quantities will be considered. It is not our intention to store complete magnet measurement data in the relation. [But, see Section IV, par.3 , below.]

Relation (6):
B_I_tranfer_func multiplicity may have to be increased to account for different ramp-rates, etc.

Connections between the relations.

The key field in relation (1), "machine_element_name" is a geographical name and applies to the element at that location in the machine configuration. The same name is used in relations (2) and (8) and refers to the same entity. In relations (2) and (7) additional information about that entity (not geographical in nature) are given. Relation (8) contains the results of calculations (under various conditions) for the layouts defined in relation (1).

The "serial_no" in relation (2) defines the specific physical device currently located as that machine_element_name; whether it is a magnet, an instrument or a member of some subsystem we may add later (such as vacuum) is defined in "subsystem_name" and its particular type (within that subsystem) is defined in "machine_element_type". These form the keys for entry into relations (3) through (7).

For magnets, "serial_no" leads us to relation (3) which gives data about that physical device; "prototype_name" leads us to relation (4) which gives data about the design-type of that "serial_no" device while "magnet_model_name" leads to relation (5) for the model-type for that magnet. "control_device name" from relation (2) provides the entry to relation (6): "magnet-strings".

For instruments, "machine_element_type" from relation (2) defines which relation (7a, 7b, etc.) contains the data for that instrument while "serial_no" is the key for entering those relations; prototype information is not separated out since, in general, instruments have only one prototype per relation.

Relations (9) and (10) are general in nature and thus do not connect with the others.

Connection with Controls:

Relation (6) "magnet_strings" is the point of connection to the controls part of the Booster operation. Don Barton has suggested that a relation connecting the magnet_string names (rows) with the various control devices corresponding to those strings (columns) would describe a "controls-matrix" which connects this part of the Booster database with that for Booster controls.

This warrants further exploration in a separate study.

Views.

The database software allows for the creation of relation-like tables, called views, which join information from several relations subject to some specified condition(s). A useful set of views can be formed by joining relations (1) and (2), forming one such view for each "machine". If, further, these are printed out in ascending s_coord order, one has a "walking list" for each machine:

```
View:  (a) machine_list_ltb
       (b) machine_list_booster
       (c) machine_list_bta

 machine_element_name      }  in relations (1), (2)

 s_coord                   >
 element_length            >  from relation (1)
 section                   >

 subsystem_name            )
 machine_element_type      )  from relation (2)
 serial_no                 )
 control_device_name       )

      subject to condition:
          machine = (a) "ltb"
                    (b) "booster"     in relation (1)
                    (c) "bta"
```

Similarly, one can join relations (3)-(6), to obtain a comple "magnet-information" view which collects information about a specific magnet, its prototype, its modelling description, etc.

Additional views can be defined as needed; since a view is formed from existing data, no changes in the underlying data are required.

IV. Expansions and Additions.

Should storage of additional data appropriate to one of the defined relations become desirable, additional fields can be added as required.

The relation structure used here for magnets and instruments is easily expanded to include such other major systems as vacuum: first, one simply adds vacuum elements to relations (1) and (2), using as subsystem_name "vacuum" and as machine_element_type the kind of vacuum device described; then one adds relations in the form of relations (7) for each kind of vacuum device (in parallel to what has been done for instruments).

Additional magnet data -- results of the measurement program not summarized by the B-to-I transfer function -- can be placed in a new relation (or separate relations for dipoles, quads, sextupoles) keyed by serial_no.

Other geographic data, such as survey results, can be placed in new relations which include both the monuments and the survey marks atop the main magnets.

Finally, we note that the structure established here can easily be expanded to include machines: "AGS", "HITL", "LEBT", etc. and to lines in the swicthyard and experimental areas, provided one has the resources to assemble and enter the data for these already existing parts of the AGS complex. The naming conventions will supply distinct machine_element_names and the separate "machines" in relation "element_layouts" can provide for separate views which produce separate "machine_lists" for each machine or line.

References

Programming Interface with the Booster Database, Examples. E.H. Auerbach and A. Luccio, Booster Tech. Note No. 162, 4/6/90.

Device Names for the AGS Facility. [updated, many times] K. Reece, unpublished. (Originally, AGS/AD Tech. Note No. 317 -- forthcoming reissue will use this number)

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General considerations: A. Luccio, K. Reece

Database matters: R. Katz, C. Griffiths

Additional discussions: D. Barton, E. Bleser, B. Culwick, R. Thomas

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APPENDIX A.

DATABASE TERMS

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relation	a relation is a basic storage unit in the database; it corresponds to a file consisting of a two-dimensional table with column headings; an entry (or record) in a relation corresponds to a row in the table.
(data-) field	a field corresponds to a column in the table (relation); the data entered in a given column may be restricted as to form, range, etc. when the relation and its fields are defined.
key	the value (data entry) of a field which is used to define uniquely a row (record) of the table (relation); the key field is usually the first data field in the relation.
view	a table consisting of data and fields selected from one or more relations, chosen according to some selection criteia. A view may look somewhat line a relation, but note this: (1) data may be retrieved from a view; (2) data may not be entered into a view since the actual data resides in the relations from which the view was defined.

APPENDIX B.
MACHINE ELEMENTS FOR BOOSTER

1. MAIN RING -- MAGNETS

Standard Element Name	Prototype Name (Magnet)
BMM.SVA1	BMS
BMM.QVA1	BMQL
BMM.DHA1	BMD
BMM.SHA2	BMS
BMM.QHA2	BMQ
BMM.DHA2	BMD
BMM.SVA3	BMS
BMM.QVA3	BMQL
BMM.SHA4	BMS
BMM.QHA4	BMQ
BMM.DHA4	BMD
BMM.SVA5	BMS
BMM.QVA5	BMQL
BMM.DHA5	BMD
BMM.SHA6	BMS
BMM.QHA6	BMQ
BMM.SVA7	BMS
BMM.QVA7	BMQL
BMM.DHA7	BMD
BMM.SHA8	BMS
BMM.QHA8	BMQ
BMM.DHA8	BMD
BMM.SVB1	BMS
BMM.QVB1	BMQL
BMM.DHB1	BMD
BMM.SHB2	BMS
BMM.QHB2	BMQ
BMM.DHB2	BMD
BMM.SVB3	BMS
BMM.QVB3	BMQL
BMM.SHB4	BMS
BMM.QHB4	BMQ
BMM.DHB4	BMD
BMM.SVB5	BMS
BMM.QVB5	BMQL
BMM.DHB5	BMD
BMM.SHB6	BMS
BMM.QHB6	BMQ
BMM.SVB7	BMS
BMM.QVB7	BMQL
BMM.DHB7	BMD
BMM.SHB8	BMS
BMM.QHB8	BMQ
BMM.DHB8	BMD

BMM.SVC1	BMS
BMM.QVC1	BMQL
BMM.DHC1	BMD
BMM.SHC2	BMS
BMM.QHC2	BMQ
BMM.DHC2	BMD
BMM.SVC3	BMS
BMM.QVC3	BMQL
BMM.SHC4	BMS
BMM.QHC4	BMQ
BMM.DHC4	BMD
BMM.SVC5	BMS
BMM.QVC5	BMQL
BMM.DHC5	BMD
BMM.SHC6	BMS
BMM.QHC6	BMQ
BMM.SVC7	BMS
BMM.QVC7	BMQL
BMM.DHC7	BMD
BMM.SHC8	BMS
BMM.QHC8	BMQ
BMM.DHC8	BMD

BMM.SVD1	BMS
BMM.QVD1	BMQL
BMM.DHD1	BMD
BMM.SHD2	BMS
BMM.QHD2	BMQ
BMM.DHD2	BMD
BMM.SVD3	BMS
BMM.QVD3	BMQL
BMM.SHD4	BMS
BMM.QHD4	BMQ
BMM.DHD4	BMD
BMM.SVD5	BMS
BMM.QVD5	BMQL
BMM.DHD5	BMD
BMM.SHD6	BMS
BMM.QHD6	BMQ
BMM.SVD7	BMS
BMM.QVD7	BMQL
BMM.DHD7	BMD
BMM.SHD8	BMS
BMM.QHD8	BMQ
BMM.DHD8	BMD

BMM.SVE1	BMS
BMM.QVE1	BMQL
BMM.DHE1	BMD
BMM.SHE2	BMS
BMM.QHE2	BMQ
BMM.DHE2	BMD
BMM.SVE3	BMS
BMM.QVE3	BMQL
BMM.SHE4	BMS
BMM.QHE4	BMQ

BMM.DHE4	BMD
BMM.SVE5	BMS
BMM.QVE5	BMQL
BMM.DHE5	BMD
BMM.SHE6	BMS
BMM.QHE6	BMQ
BMM.SVE7	BMS
BMM.QVE7	BMQL
BMM.DHE7	BMD
BMM.SHE8	BMS
BMM.QHE8	BMQ
BMM.DHE8	BMD
BMM.SVF1	BMS
BMM.QVF1	BMQL
BMM.DHF1	BMD
BMM.SHF2	BMS
BMM.QHF2	BMQ
BMM.DHF2	BMD
BMM.SVF3	BMS
BMM.QVF3	BMQL
BMM.SHF4	BMS
BMM.QHF4	BMQ
BMM.DHF4	BMD
BMM.SVF5	BMS
BMM.QVF5	BMQL
BMM.DHF5	BMD
BMM.SHF6	BMS
BMM.QHF6	BMQ
BMM.SVF7	BMS
BMM.QVF7	BMQL
BMM.DHF7	BMD
BMM.SHF8	BMS
BMM.QHF8	BMQ
BMM.DHF8	BMD

2. MISCELLANEOUS KICKERS, SEPTA, Etc.

Standard Element Name	
BIJ.KRB8	Injection Kicker (H.I.)
BIJ.KRC3	Injection Kicker (P's and H.I.)
BIJ.KRC6	Injection Kicker (P's and H.I.)
BIJ.KRC8	Injection Kicker (P's)
BIJ.FOILC5	Injection Foil
BIJ.SPTMC3	Electro-static Septum

BGN.KRE3	Damping Kicker
BGN.KRD3	Dump Kicker
BGN.KRE3	Tune Kicker
BXT.KRF3	Ejection Kicker
BXT.SPTMF6	Ejection Septum

3. TRIM MAGNETS AND OTHER CORRECTORS

Correction Dipoles

Trim Dipoles

Trim Quads

Trim Sextupoles

4. INSTRUMENTATION

BPM's:

BMD.PUE_V.A1
BMD.PUE_H.A2
BMD.PUE_V.A3
BMD.PUE_H.A4
BMD.PUE_V.A5
BMD.PUE_H.A6
BMD.PUE_V.A7
BMD.PUE_H.A8

BMD.PUE_V.B1
BMD.PUE_H.B2
BMD.PUE_V.B3
BMD.PUE_H.B4
BMD.PUE_V.B5
BMD.PUE_H.B6
BMD.PUE_V.B7
BMD.PUE_H.B8

BMD.PUE_V.C1
BMD.PUE_H.C2
BMD.PUE_V.C3
BMD.PUE_H.C4
BMD.PUE_V.C5
BMD.PUE_H.C6
BMD.PUE_V.C7
BMD.PUE_H.C8

BMD.PUE_V.D1
BMD.PUE_H.D2

```
  BMD.PUE_V.D3
  BMD.PUE_H.D4
  BMD.PUE_V.D5
                 note: D6 missing.
  BMD.PUE_V.D7
  BMD.PUE_H.D8

  BMD.PUE_V.E1
  BMD.PUE_H.E2
  BMD.PUE_V.E3
  BMD.PUE_V.E34  } note: additional PUE's
  BMD.PUE_H.E34  }         for damper control
  BMD.PUE_H.E4
  BMD.PUE_V.E5
  BMD.PUE_H.E6
  BMD.PUE_V.E7
  BMD.PUE_H.E8

  BMD.PUE_V.F1
  BMD.PUE_H.F2
  BMD.PUE_V.F3
  BMD.PUE_H.F4
  BMD.PUE_V.F5
                 note: F6 missing.
  BMD.PUE_V.F7
  BMD.PUE_H.F8


Current Transformer:
  BMD.CURR_TRANS.C6


Wall Monitors:
  BMD.WALL_MON.D6
  BMD.WALL_MON.E3


(Ionization) Profile Monitors:
  BMD.IPM_H.D3
  BMD.IPM_V.D3


Radiation Monitors:
  BMD.RAD_MON.xx
```

APPENDIX C.
MACHINE ELEMENTS FOR LTB-LINE

Standard Element Name	Prototype Name (Magnet)	Machine Element Type
Major Magnets:		
BLI.KR1	KRIL	
BLI.QH1	4Q10	
BLI.QV2	4Q10	
BLI.QH3	4Q10	
BLI.QV4	4Q10	
BLI.QH5	4Q10	
BLI.DH1	2.5D45	
BLI.DH2	2.5D45	
BLI.QH6	4Q10	
BLI.DH3	2.5D45	
BLI.QH7	4Q10	
BLI.DH4	2.5D45	
BLI.QH8	4Q10	
BLI.QV9	4Q10	
BLI.QH10	4Q10	
BLI.QV11	4Q10	
BLI.QH12	4Q10	
BLI.QV13	4Q10	
Steering magnets:		
BLI.DH015		kicker
BLI.DV018		kicker
BLI.DV026		kicker
BLI.DH075		kicker
BLI.DV082		kicker
BLI.DH088		kicker
BLI.DV095		kicker
BLI.DV112		fast kicker
Instruments:		
BLI.BPM019		strip_line_pm
BLI.BPM026		strip_line_pm
BLI.BPM066		strip_line_pm
BLI.BPM078		strip_line_pm
BLI.BPM090		strip_line_pm
BLI.BPM102		strip_line_pm
BLI.BPM109		strip_line_pm
BLI.MW035		harp
BLI.MW107		harp

[Note: The HTB-Line has not yet been specified; elements will have names of form: BHI.xxxxx]

APPENDIX D.
MACHINE ELEMENTS FOR BTA-LINE

Standard Element Name	Prototype Name (Magnet)	
ABI.QV1	4Q20	
ABI.DV1	2D20	
ABI.QH2	4Q20)	pair
	4Q20)	
ABI.QV3	4Q20	
ABI.QH4	4Q20	
ABI.DH2	BMD	
ABI.QV5	6.5Q20	
ABI.DH3	BMD	
ABI.QH6	6.5Q20	
ABI.QV7	6.5Q20	
ABI.QH8	6.5Q20	
ABI.DH4	2.5D6	
ABI.QV9	6.5Q20	
ABI.QH10	6.5Q20	
ABI.QV11	6.5Q20	
ABI.QH12	6.5Q20	
ABI.QV13	6.5Q20	
ABI.QH14	6.5Q20	
ABI.DH5	2.5D48	
ABI.QV15	4Q20	

APPENDIX E.
DICTIONARY of ALLOWED NAMES for VARIOUS FIELDS

Field Name	Allowed Values
control_device_name	<to be assigned in consultation with controls group>
machine	BOOSTER BTA LTB [HTB]
machine_element_name	standard name (in Reece convention) [see lists in App. B-C-D for names]
machine_element_type	for magnets, etc.: magnet-type, e.g., dipole quad sext kicker foil septum for instruments: instrument-type, e.g., strip_line_pm pue curr_transf wall_mon harp ipm rad_mon
magnet_class	dipole quad sext
magnet_model_name	these are names conventionally used in model-programs such as "MAD", "SYNCH", etc. and will be assigned by the modellers.
section	for BOOSTER: A1 to F8 for a line: distance in feet from start of line, or a section-number (if that line has numbered sections) [usually a three character number with lead zeros]
ser_no	serial number of an actual magnet,instrument, etc., -- formed by joining a prototype_name (possibly abbreviated) with a two or three digit number. E. g., BMQ-025
subsystem_name	magnets instruments

APPENDIX F.

QLI> print MAGNET_PROTOTYPES

PROTOTYPE NAME	MAGNET CLASS	MAGNETIC LENGTH	CORE LENGTH	PHYSICAL LENGTH	APERT TYPE	APERT X	APERT Y	GAP HEIGHT	POLE WIDTH	POLE TIP RADIUS	RESISTANCE	INDUCTANCE	NO MAGNETS	COMMENTS
BMD	dipole	2.4	2.31744	2.37	rect	152	70	82.55	254		1.5	3.2	37	Booster Main Dipoles (36 + 1 spare) 2 additional used in "BTA"
BMQ	quad	0.47835			ellp	66	66		127	82.55	0.9	0.35	25	Booster Main Quadrupoles (short version) used for Horiz.-focussing quads
BMQL	quad	0.49105			ellp	66	66		127	82.55	0.9	0.35	25	Booster Main Quadrupoles (longer version) used for Vert.-focussing quads
BMS	sext	0.1	0.1							82.55	7.6	0.12	48	Booster Main Sextupoles
4Q10	quad	0.3		0.254	ellp	100	100						13	Linac-to-Booster Line Quads
2.5D45	dipole	1.2		1.143	rect	63	63						4	Linac-to-Booster Line Dipoles
2D20	dipole	0.5			ellp	50	50						1	BTA Line Dipole
2.5D6	dipole	0.1562			ellp	63	63						1	BTA Line Dipole
2.5D48	dipole	1.2345			rect	63	63						1	BTA Line Dipole
4Q20	quad	0.5			ellp	100	100						6	BTA Line Quads
6.5Q20	quad	0.5			ellp	163	163						10	BTA Line Quads