[RULES]

Purpose:

Defines rule-based controls that modify links based on a combination of conditions.

Format:

Each rule is a series of statements of the form:

```
RULE ruleID
IF  condition_1
AND condition_2
OR  condition_3
AND condition_4
etc.
THEN action_1
AND  action_2
etc.
ELSE action_3
AND  action_4
etc.
PRIORITY value
```

where:

`ruleID`	=	an ID label assigned to the rule
`conditon_n`	=	a condition clause
`action_n`	=	an action clause
`Priority`	=	a priority value (e.g., a number from 1 to 5)

Condition Clause Format:

A condition clause in a Rule-Based Control takes the form of:

```
object id attribute relation value
```

where

`object`	=	a category of network object
`id`	=	the object's ID label
`attribute`	=	an attribute or property of the object
`relation`	=	a relational operator
`value`	=	an attribute value

Some example conditional clauses are:

```
JUNCTION 23 PRESSURE > 20
TANK T200 FILLTIME BELOW 3.5
LINK 44 STATUS IS OPEN
SYSTEM DEMAND >= 1500
SYSTEM CLOCKTIME = 7:30 AM
```

The Object keyword can be any of the following:

NODE	**LINK**	**SYSTEM**
JUNCTION	**PIPE**	
RESERVOIR	**PUMP**	
TANK	**VALVE**	

When **SYSTEM** is used in a condition no ID is supplied.

The following attributes can be used with Node-type objects:

DEMAND

HEAD

PRESSURE

The following attributes can be used with Tanks:

LEVEL

FILLTIME (hours needed to fill a tank)

DRAINTIME (hours needed to empty a tank)

These attributes can be used with Link-Type objects:

FLOW

STATUS (**OPEN**, **CLOSED**, or **ACTIVE**)

SETTING (pump speed or valve setting)

The **SYSTEM** object can use the following attributes:

DEMAND (total system demand)

TIME (hours from the start of the simulation expressed either as a decimal number or in hours:minutes format)

CLOCKTIME (24-hour clock time with **AM** or **PM** appended)

Relation operators consist of the following:

=	**IS**
<>	**NOT**
<	**BELOW**
>	**ABOVE**
<=	**>=**

Action Clause Format:

An action clause in a Rule-Based Control takes the form of:

```
object id STATUS/SETTING IS value
```

where

object	=	**LINK**, **PIPE**, **PUMP**, or **VALVE** keyword
id	=	the object's ID label
value	=	a status condition (**OPEN** or **CLOSED**), pump speed setting, or valve setting

Some example action clauses are:

```
LINK 23 STATUS IS CLOSED
PUMP P100 SETTING IS 1.5
VALVE 123 SETTING IS 90
```

Remarks:

a. Only the **RULE**, **IF** and **THEN** portions of a rule are required; the other portions are optional.

b. When mixing **AND** and **OR** clauses, the **OR** operator has higher precedence than **AND**, i.e.,

```
IF A or B and C
```

is equivalent to

```
IF (A or B) and C.
```

If the interpretation was meant to be

```
IF A or (B and C)
```

then this can be expressed using two rules as in

```
IF A THEN ...
IF B and C THEN ...
```

c. The **PRIORITY** value is used to determine which rule applies when two or more rules require that conflicting actions be taken on a link. A rule without a priority value always has a lower priority than one with a value. For two rules with the same priority value, the rule that appears first is given the higher priority.

Example:

```
[RULES]
RULE 1
IF    TANK   1 LEVEL ABOVE 19.1
THEN PUMP 335 STATUS IS CLOSED
AND  PIPE 330 STATUS IS OPEN

RULE 2
IF    SYSTEM CLOCKTIME >= 8 AM
AND  SYSTEM CLOCKTIME < 6 PM
AND  TANK 1 LEVEL BELOW 12
THEN PUMP 335 STATUS IS OPEN

RULE 3
IF    SYSTEM CLOCKTIME >= 6 PM
OR   SYSTEM CLOCKTIME < 8 AM
AND  TANK 1 LEVEL BELOW 14
THEN PUMP 335 STATUS IS OPEN
```