Normalization proof for all relations (all relations are in BCNF).

Customer

FDs
Customer_ID → {Customer_Name, Phone_Number, Billing_Cycle, Block/Flate_No, Street, Connection_Status, Feedback, Customer_Type_ID, Pin-Code}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Customer Type

FDs
Customer_Type_ID → {Type_Name, Description}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Bill

FDs
Bill_ID → {Billing_Date, Total_Price, Payment_Status, Meter_ID, Rate_ID}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Meter

FDs
Meter_ID → {Current_Reading, Installation_Date, Status, Last_Reading_Date, Customer_ID, Station_ID}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Water Rate

FDs
Rate_ID → {Customer_Type_ID, Rate_Start_Date, Rate_End_Date, Water_rate, Corporation_ID}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Water Distribution Station

FDs
Station_ID → {Water_Level, S_Capacity, Number_Of_Meters, Reservoir_ID, Pin-Code}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Water Reservoir

FDs
Reservoir_ID → {Status, Water_Level,R_Capacity, Plant_ID, Pin-Code}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Purification Plant

FD
Plant_ID → {P_Capacity, Plant_Type, Pin-Code}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Purifies (M–N Relationship Table)

FD
{Plant_ID, Water_Source_ID} → { After_WQI, Before_WQI}

BCNF Check
In a junction table where the composite key is the only key, there is no violation of BCNF.

Water Source

FDs

Water_Source_ID → {Type, W_Capacity, Status, Area, Corporation_ID, Pin-Code}

BCNF Check

The FD has the candidate key as its determinant, so the relation is in BCNF.

Municipal Corporation

FDs

Corporation_ID → {Name, Contact_Info, Pin-Code}

BCNF Check

The FD has the candidate key as its determinant, so the relation is in BCNF.

Employee

FDs

Employee_ID → {Employee_Name, Role, Department, Salary, Contact_Info, Team_ID, Reservoir_ID}

BCNF Check

The FD has the candidate key as its determinant, so the relation is in BCNF.

Outage

FDs

Outage_ID → {Start_Date_Time, End_Date_Time, Status, Outage_Type, Cause, Maintenance_ID}

BCNF Check

The FD has the candidate key as its determinant, so the relation is in BCNF.

Affected Area

FDs

Affected_Area_ID → {Area_Type, Outage_ID, Pin-Code}

BCNF Check

The FD has the candidate key as its determinant, so the relation is in BCNF.

Maintenance Team

FD
  Team_ID → {Team_Type}

BCNF Check
  The FD has the candidate key as its determinant, so the relation is in BCNF.

Maintenance Schedule

FD:
  Maintenance_ID → {Date, Start_Time, End_Time, Maintenance_Type, Status, Team_ID, Reservoir_ID}

BCNF Check
  The FD has the candidate key as its determinant, so the relation is in BCNF.

Pin-Code

FD
  Pin_Code → {City, State, District, Area}

BCNF Check
The FD has the candidate key as its determinant, so the relation is in BCNF.

Overall BCNF Check:

All the **Functional Dependencies** we've listed have the **LHS as a superkey** — **no partial or transitive dependencies with non-superkeys**, and no composite candidate keys being violated by a dependency.

Thus it is BCNF.