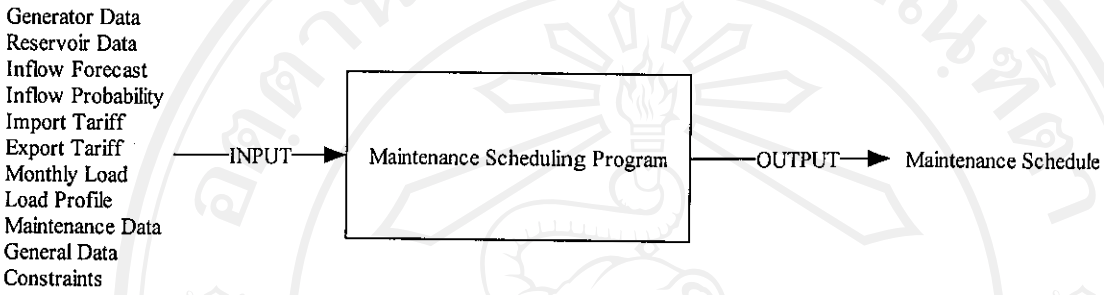
Appendix A

Software Algorithm

A.1 Program Flowchart



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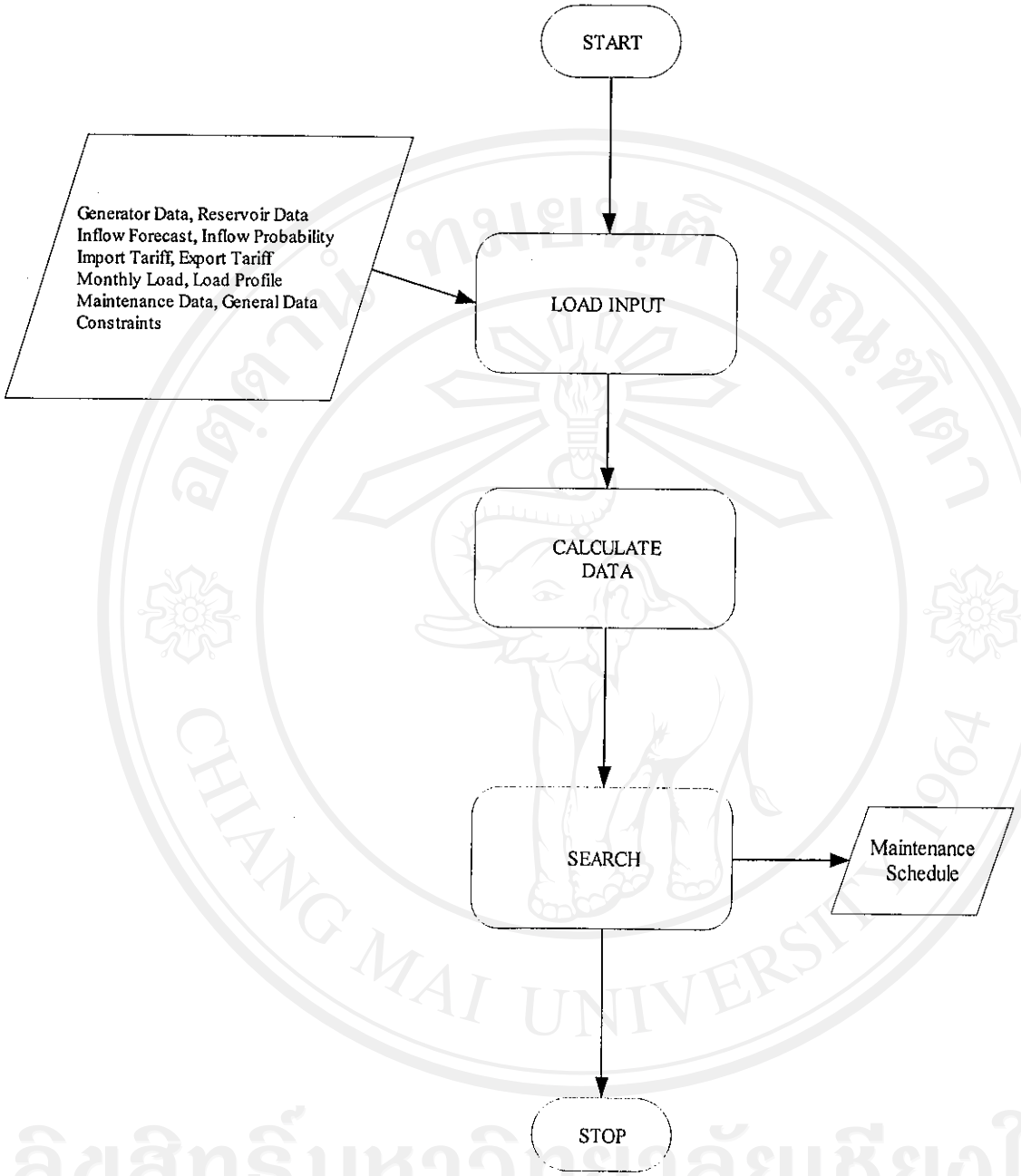

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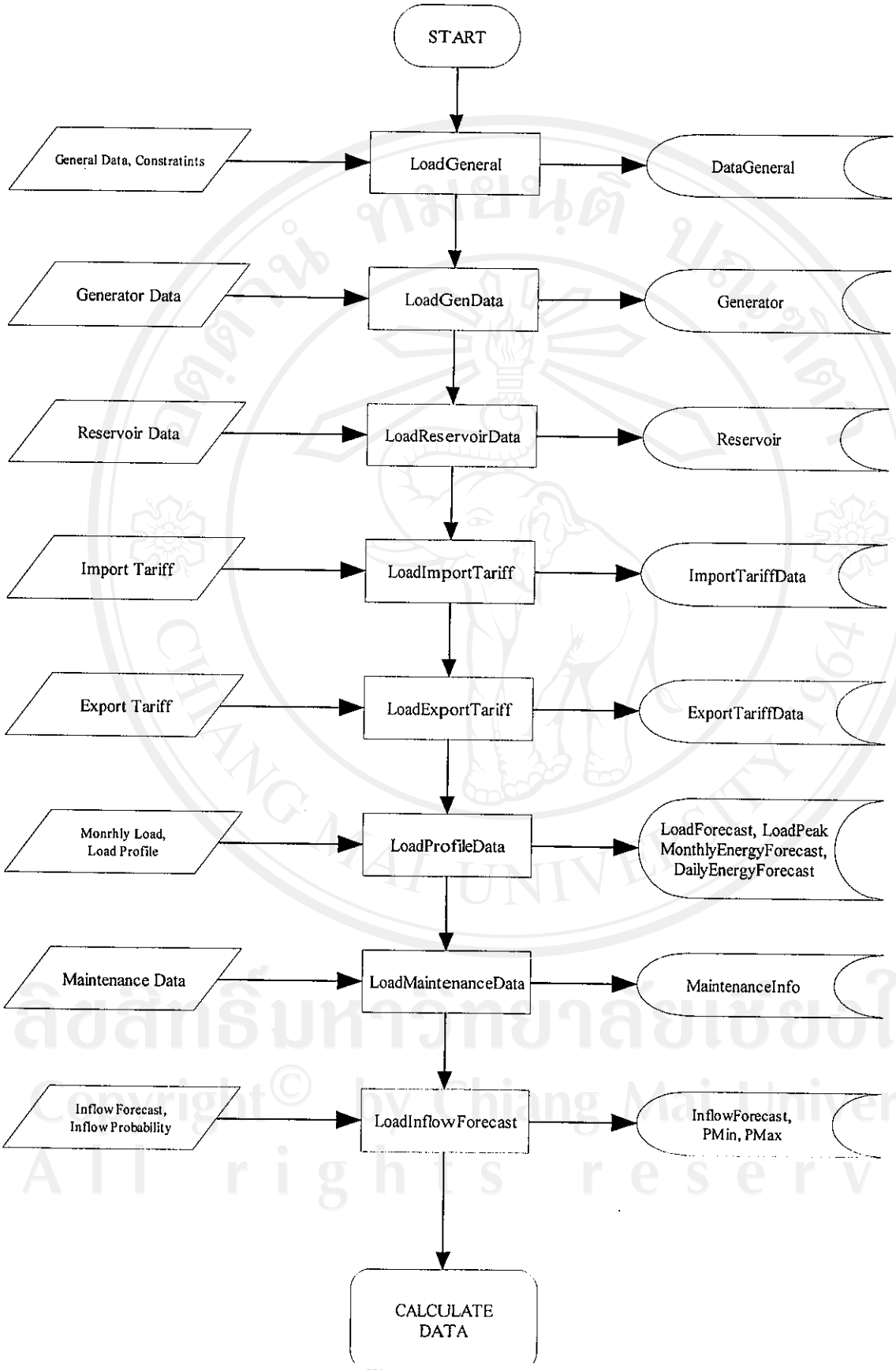

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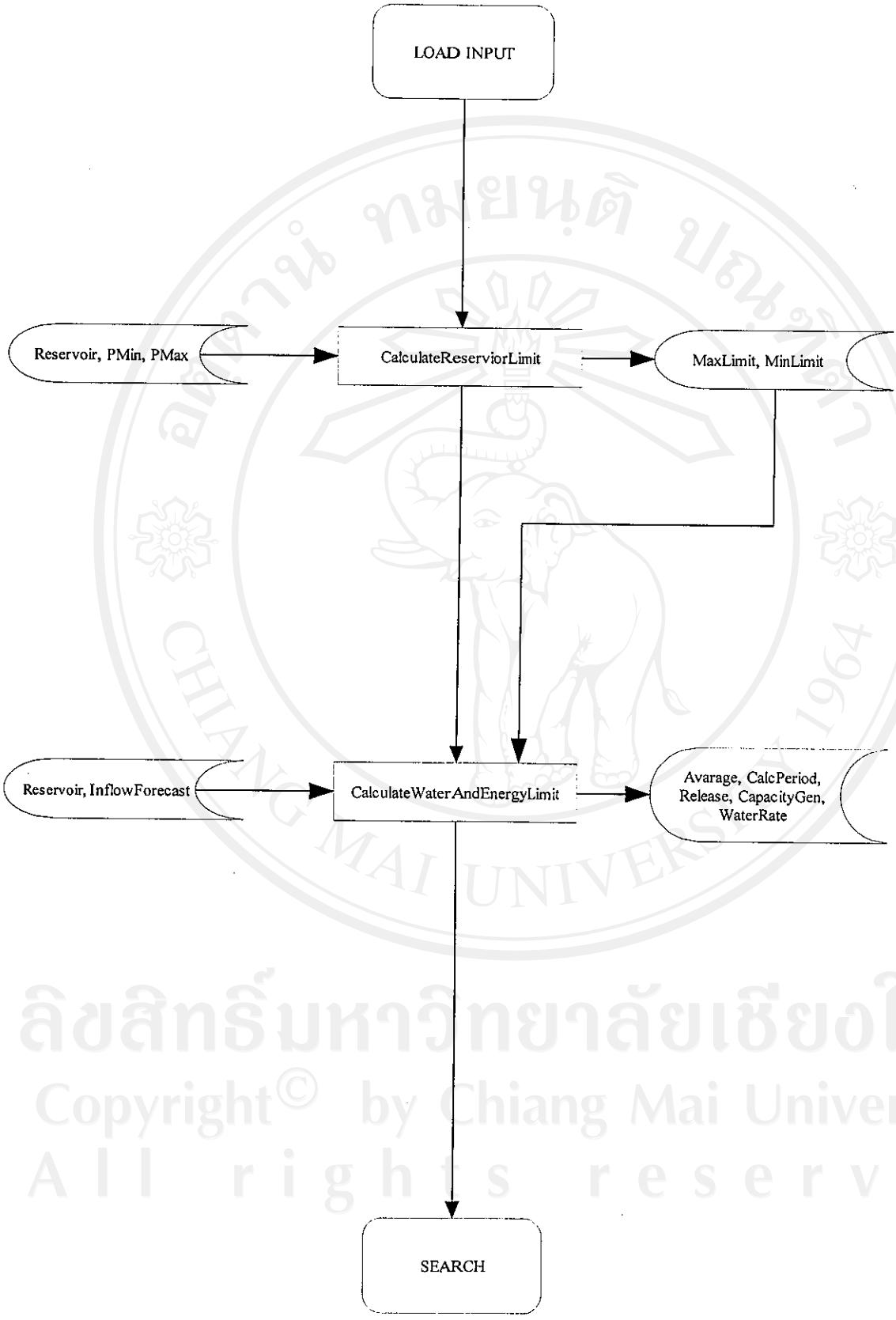

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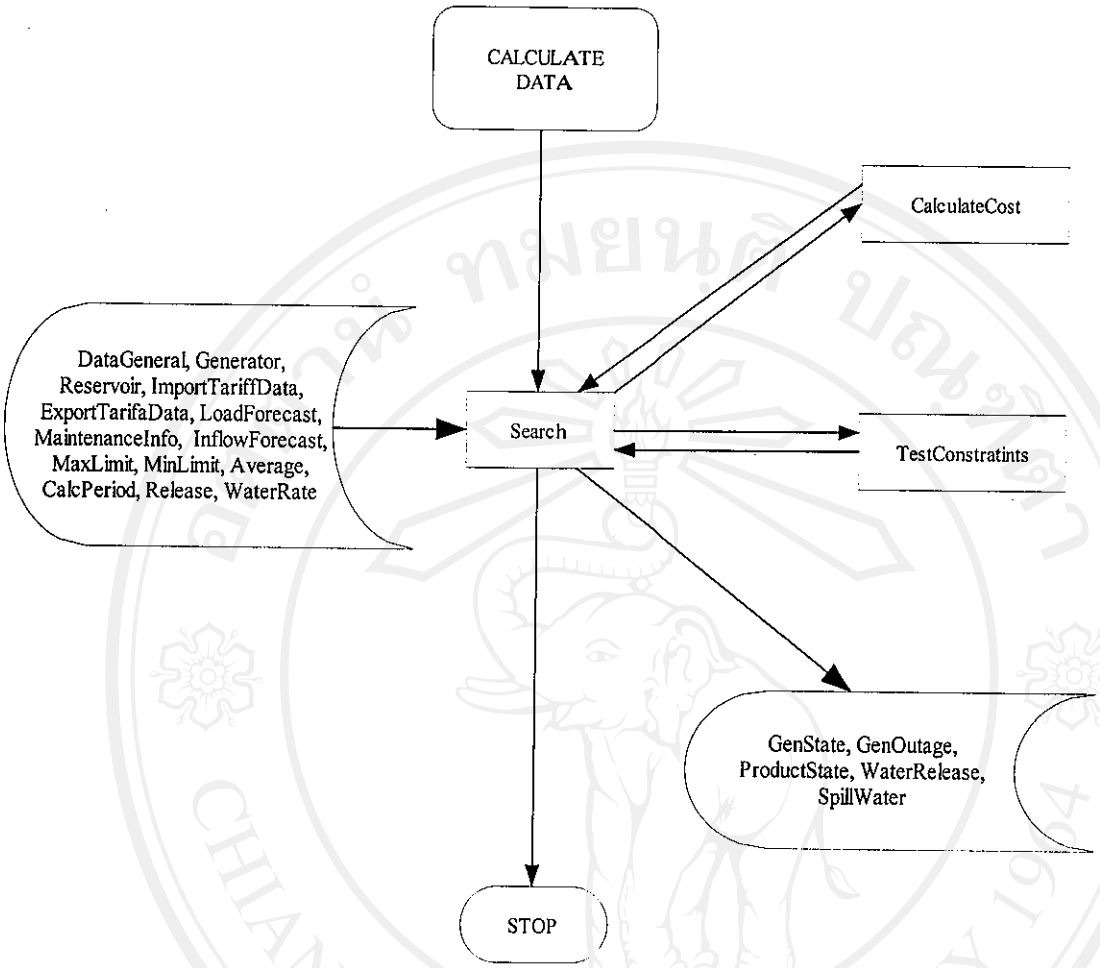

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DataGeneral
.StartDate
.EndDate
.MaximumManPower
.MaximumImportMW
.MaximumExportMW
Use: DataGeneral

Generator
.UnitName
.Capacity
.New_Status
.Retire_Status
.New_Retire_Date
.k1
.q
Use: Generator(generator#)

Reservoir
.ReservoirName
.InitialVolume
.EndedVolume
.MaxTurbineFlow
.PeakOperation
.MaxCapacity
.InflowSeason
.TotalEvap
.NumberOfGenerator
.Va
.Vb
.Vc
.Vd
.Ve
.Vf
Use: Reservoir(reservoir#)

MaintenanceInfo
.MaintenanceCount
.MinimumAvail
.Maintenance(maintenance#)
.Reservoir
.UnitName
.PossibleStart
.PossibleFinish
.DaysNeeded
.ManpowerNeeded
Use: MaintenanceInfo(generator#)

InflowForecast
.ReservoirName
.Month(month#)
Use: InflowForecast(reservoir#)

ImportTariffData
.WeekDay(month#, hour#)
.Hol_Sat_Sun(month#, hour#)
Use: ImportTariffData

ExportTariffData
.WeekDay(month#, hour#)
.Hol_Sat_Sun(month#, hour#)
Use: ExportTariffData

CalcPeriod
.StartMonth
.StopMonth
.StartHour
.StopHour
Use: CalcPeriod(reservoir#, month#)

GenOutage
.StartDate
.StopDate
USE: GenOutage(generator#, maintenance#, day#)

LoadForecast(day#, hour#)
LoadPeak(day#)
MonthlyEnergyForecast(month#)
DailyEnergyForecast(day#)
PMin(reservoir#, month#)
PMax(reservoir#, month#)
MaxLimit(reservoir#, month#)
MinLimit(reservoir#, month#)
TotalCalcPeriod(reservoir#)
Average(reservoir#, month#)
Release(reservoir#, month#)
CapacityGen(gerator#, month#)
WaterRate(generator#, month#)
GenState(generator#, day#)
ProductState(generator#, hour#)
WaterRelease(reservoir#, month#)
SpillWater(month#)

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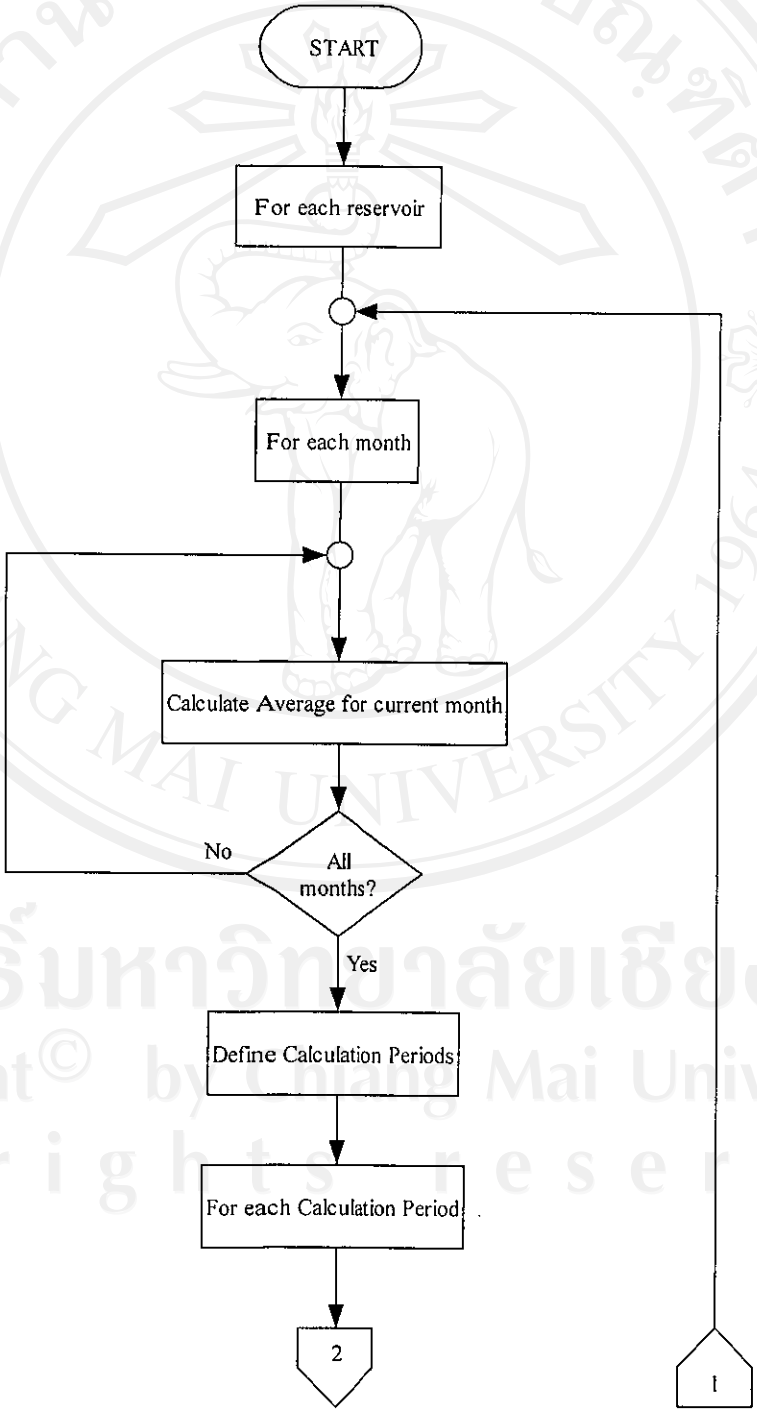
A.2 CalculateWaterAndEnergyLimit

Input:
- Reservoir(reservoir#)
- InflowForecast(reservoir#)

Output:
- Average(reservoir#, month#)
- CalcPeroid(reservoir#, calcP#)
- TotalCalcPeriod(reservoir#)
- Release(reservoir#, calcP#)
- CapacityGen(generator#, calcP#)
- WaterRate(generator#, calcP#)

LocalVariable:
- TotalInflow(calcP#)
- HeadStart(calcP#)
- HeadStop(calcP#)



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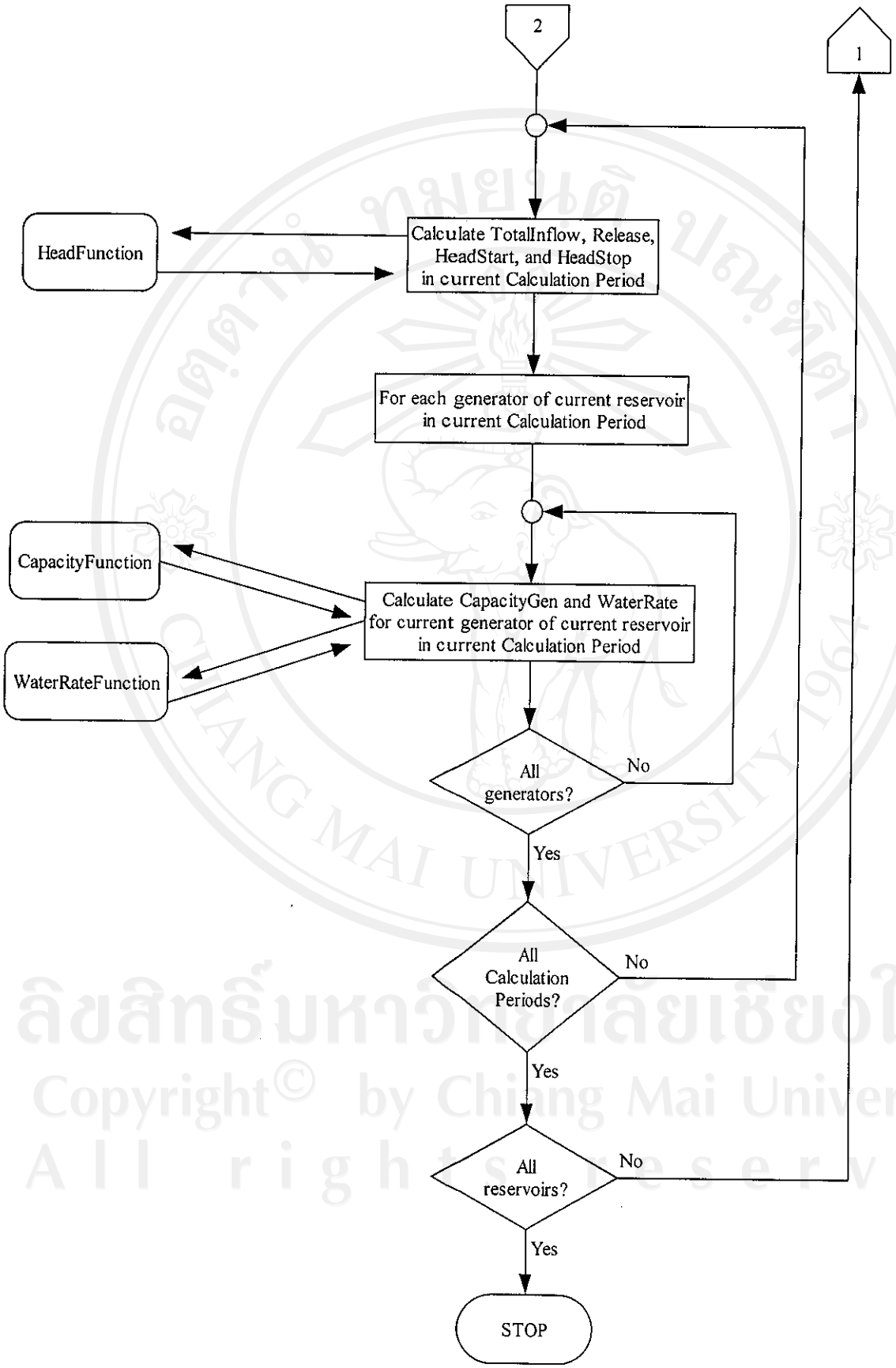

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Calculate Average for current month

```
Average(current reservoir, current month) =

                    (MaxLimit(current reservoir, current month) + MinLimit(current reservoir, current month)) / 2
```

Define Calculation Periods

```
calcP = 1
StartMonth = 1 (or first month of maintenance schedule)
Do
  CalcPeriod(current reservoir, calcP).StartMonth = StartMonth
  StopMonth = StartMonth
  If StopMonth = total number of months Then
    CalcPeriod(current reservoir, calcP).StopMonth = StopMonth
    Exit Do
  Else
    Do until Average(current reservoir, StopMonth) <= Average(current reservoir, StopMonth + 1)
      StopMonth = StopMonth + 1
      If StopMonth >= total number of months Then
        CalcPeriod(current reservoir, calcP).StopMonth = StopMonth
        Exit Do
      End If
    Loop
  End If
  If StopMonth = StartMonth Then
    If Average(current reservoir, StopMonth) < Average(current reservoir, StopMonth + 1)
      Do
        StopMonth = StopMonth + 1
        If StopMonth >= total number of months Then
          CalcPeriod(current reservoir, calcP).StopMonth = StopMonth
          Exit Do
        End If
      Loop until Average(current reservoir, StopMonth) >= Average(current reservoir, StopMonth + 1)
    End If
  End If
  CalcPeriod(current reservoir, calcP).StopMonth = StopMonth
  If StopMonth >= total number of months Then
    Exit Do
  End If
  calcP = calcP + 1
  StartMonth = StopMonth + 1
Loop until StopMonth >= total number of months

TotalCalcPeroid(current reservoir) = calcP    (save total number of calculation periods of current reservoir)
```

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Calculate Release, HeadStart, and HeadStop in current Calculation Period

```
TotalInflow(current calcP) = Sum of InflowForecast(current reservoir).Month(month#) from
                             month# = StartMonth of current Calculation Period to StopMonth of current Calculation Period

Select Case current calcP
  Case current calcP is first period
    Release(current reservoir, current calcP) = Reservoir(current reservoir).InitialVolume
                                              + TotalInflow(current calcP)
                                              - Average(current reservoir, StopMonth of Current calculation Period)
                                              - (Reservoir(current reservoir).TotalEvap * number of months in current Calculation Peroid)

    HeadStart(current calcP) = HeadFunction(current reservoir, Reservoir(current reservoir).InitialVolume)

    HeadStop(current calcP) = HeadFunction(current reservoir,
                                           Average(current reservoir, StopMonth of current Calculation Period))

  Case current calcP is between first period and last period
    Release(current reservoir, current calcP) = Average(current reservoir, StopMonth of previous Calculation Period)
                                              + TotalInflow(current calcP)
                                              - Average(current reservoir, StopMonth of Current calculation Period)
                                              - (Reservoir(current reservoir).TotalEvap * number of months in current Calculation Peroid)

    HeadStart(current calcP) = HeadFunction(current reservoir,
                                           Average(current reservoir, StopMonth of previous Calculation Period))

    HeadStop(current calcP) = HeadFunction(current reservoir,
                                           Average(current reservoir, StopMonth of current Calculation Period))

  Case current calcP is last period
    Release(current reservoir, current calcP) = Average(current reservoir, StopMonth of previous Calculation Period)
                                              + TotalInflow(current calcP)
                                              - Reservoir(current reservoir).EndedVolume
                                              - (Reservoir(current reservoir).TotalEvap * number of months in current Calculation Peroid)

    HeadStart(current calcP) = HeadFunction(current reservoir,
                                           Average(current reservoir, StopMonth of current Calculation Period))

    HeadStop(current calcP) = HeadFunction(current reservoir,
                                           Average(current reservoir, Reservoir(current reservoir).EndedVolume)

End Select
```

Calculate CapacityGen and WaterRate for current generator of current reservoir in current Calculation Period

```
CapacityGen(current generator, current calcP) = CapacityFunction(current generator,
                                                (HeadStart(current reservoir, current calcP)
                                                 + HeadStop(current reservoir, current calcP)) /2)

WaterRate(current generator, current calcP) = WaterRateFunction(current generator,
                                              (HeadStart(current reservoir, current calcP)
                                               + HeadStop(current reservoir, current calcP)) /2)
```

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A.3 HeadFunction

Input:
- Reservoir Number
- Volume

Output:
- Head value

Calculate Head value with formula $y = V_a x^5 + V_b x^4 + V_c x^3 + V_d x^2 + V_e x + V_f$

```
Return Head = Reservoir(reservoir#).Va * Volume * Volume * Volume * Volume * Volume)
            + (Reservoir(reservoir#).Vb * Volume * Volume * Volume * Volume)
            + (Reservoir(reservoir#).Vc * Volume * Volume * Volume)
            + (Reservoir(reservoir#).Vd * Volume * Volume)
            + (Reservoir(reservoir#).Ve * Volume)
            + Reservoir(reservoir#).Vf
```

CapacityFunction

Input:
- Generator Number
- Head

Output:
- Capacity value (MW)

Calculate Head value with formula $Capacity = \frac{k_1 \times q \times head}{1000}$

```
Capacity = 0
  Capacity = (Generator(generator#).k1 * Generator(generator#).q * Head) / 1000
  If Capacity > Generator(generator#).Capacity Then
    (NOTE: If the calculated value is greater than unit's capacity, use the unit's capacity instead)
    Capacity = Generator(generator#).Capacity
  End If
Return Capacity
```

WaterRateFunction

Input:
- Generator Number
- Head

Output:
- Water Rate

Calculate Water Rate with formula $WaterRate = \frac{q \times 3.6}{Capacity}$

```
Return WaterRate = (Generator(generator#).q * 3.6) / CapacityFunction(generator#, Head)
```

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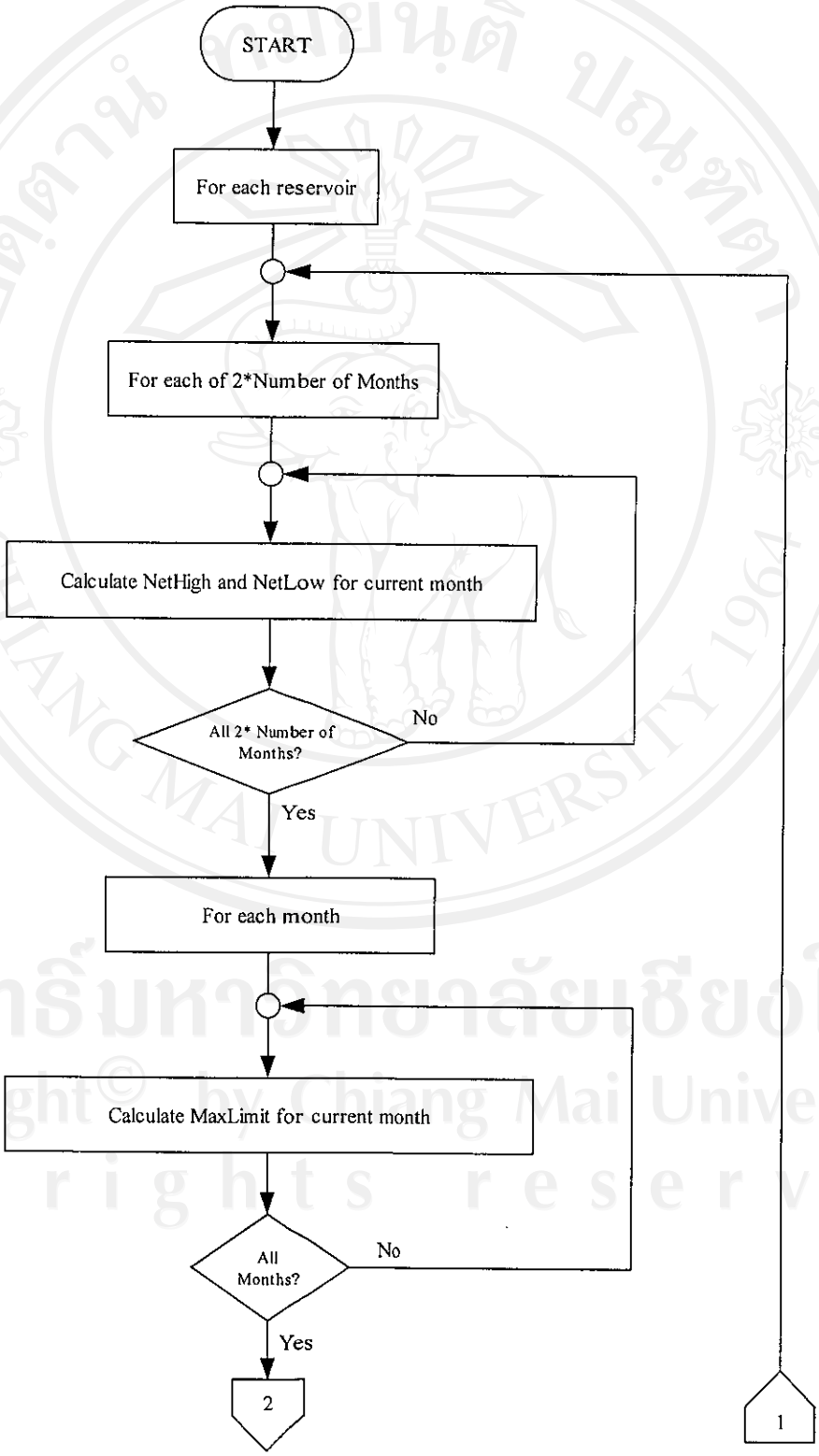
A.4 CalculateReservoirLimit

Input:
- PMin(reservoir#, month#)
- PMax(reservoir#, month#)
- Reservoir(reservoir#)

Output:
- MaxLimit(reservoir#, month#)
- MinLimit(reservoir#, month#)

LocalVariable:
- NetHigh(reservoir#, month#)
- NetLow(reservoir#, month#)



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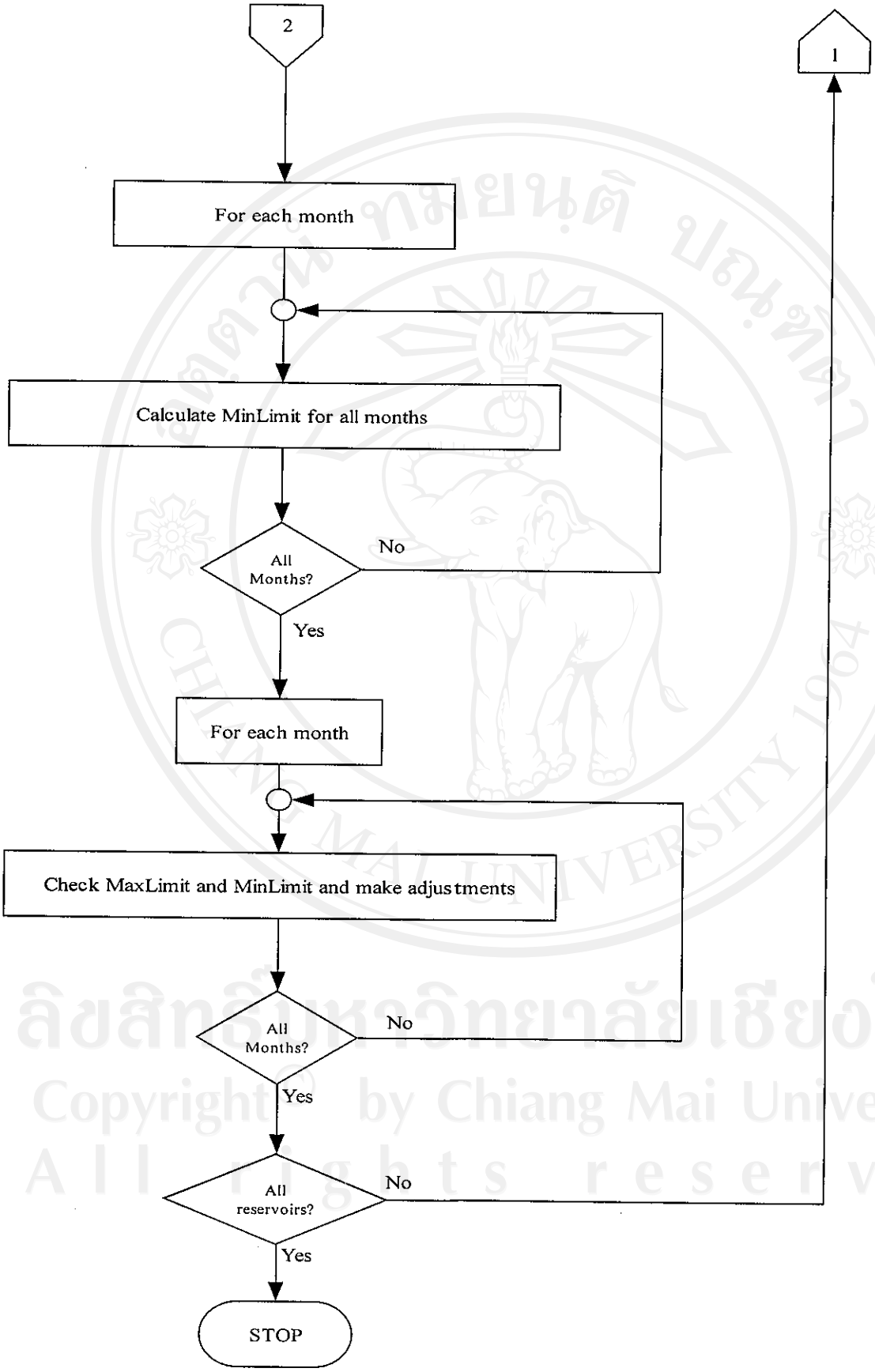

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Calculate NetHigh and NetLow for each of 2*Number of Months

```
NetHigh(current reservoir, current month) = PMax(current reservoir, current month) -
                                            Reservoir(current reservoir).MaxTurbineFlow(current month)

NetHigh(current reservoir, current month + 12) = NetHigh(current reservoir, current month)

NetLow(current reservoir, current month) = PMin(current reservoir, current month) -
                                           Reservoir(current reservoir).PeakOperation(current month)

NetLow(current reservoir, current month + 12) = NetLow(current reservoir, current month)
```

Calculate MaxLimit for each month

```
MaxLimit(current reservoir, current month) = Reservoir(current reservoir).Maxcapacity
next month = current month +1
Do
  MaxLimit(current reservoir, current month) = MaxLimit(current reservoir, current month) -
                                               NetHigh(current reservoir, next month)
  next month = next month + 1
Loop Until NetHigh(current reservoir, next month) < 0
```

Calculate MinLimit for each month

```
MinLimit(current reservoir, current month) = 0
next month = current month + 1
Do
  MinLimit(current reservoir, current month) = MinLimit(current reservoir, current month) -
                                               NetLow(current reservoir, next month)
  next month = next month + 1
Loop Until NetLow(current reservoir, next month) < 0
```

Check MaxLimit and MinLimit and make adjustments for each month

```
If MaxLimit(current reservoir, current month) > Reservoir(current reservoir).Maxcapacity Then
  MaxLimit(current reservoir, current month) = Reservoir(current reservoir).Maxcapacity
End If

If MinLimit(current reservoir, current month) < 10% of Reservoir(current reservoir).Maxcapacity Then
  MinLimit(current reservoir, current month) = 10% of Reservoir(current reservoir).Maxcapacity
End If

If MaxLimit(current reservoir, current month) < MinLimit(current reservoir, current month) Then
  MaxLimit(current reservoir, current month) = MinLimit(current reservoir, current month)
End If
```

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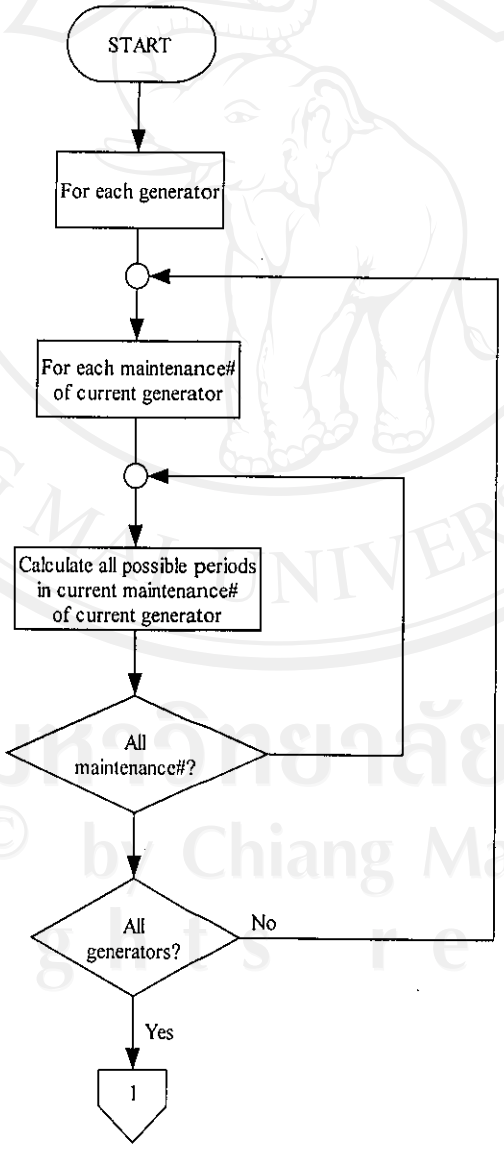
A.5 Search

Input:
- DataGeneral
- Generator(generator#)
- Reservoir(reservoir#)
- ImportTariffData
- ExportTarifaData
- LoadForecast(day#, hour#)
- LoadPeak(day#)
- MaintenanceInfo(generator#)
- InflowForecast(reservoir#)
- MaxLimit(reservoir#, month#)
- MinLimit(reservoir#, month#)
- Average(reservoir#, month#)
- CalcPeriod(reservoir#, month#)
- TotalCalcPeriod(reservoir#)
- Release(reservoir#, month#)
- CapacityGen(generator#, calcP#)
- WaterRate(generator#, month#)

Output:
- GenState(generator#, day#)
- GenOutage(generator#, maintenance#, day#)
- ProductState(generator#, hour#)
- WaterRelease(reservoir#, month#)
- SpillWater(month#)

LocalVariable:
- TotalPeroid(generator#, maintenance#)
- VoidMultiple(generator#, maintenance# - 1, maintenance#)
- VoidCrew
- VoidReserve
- Crew
- Reserve
- MinReserve



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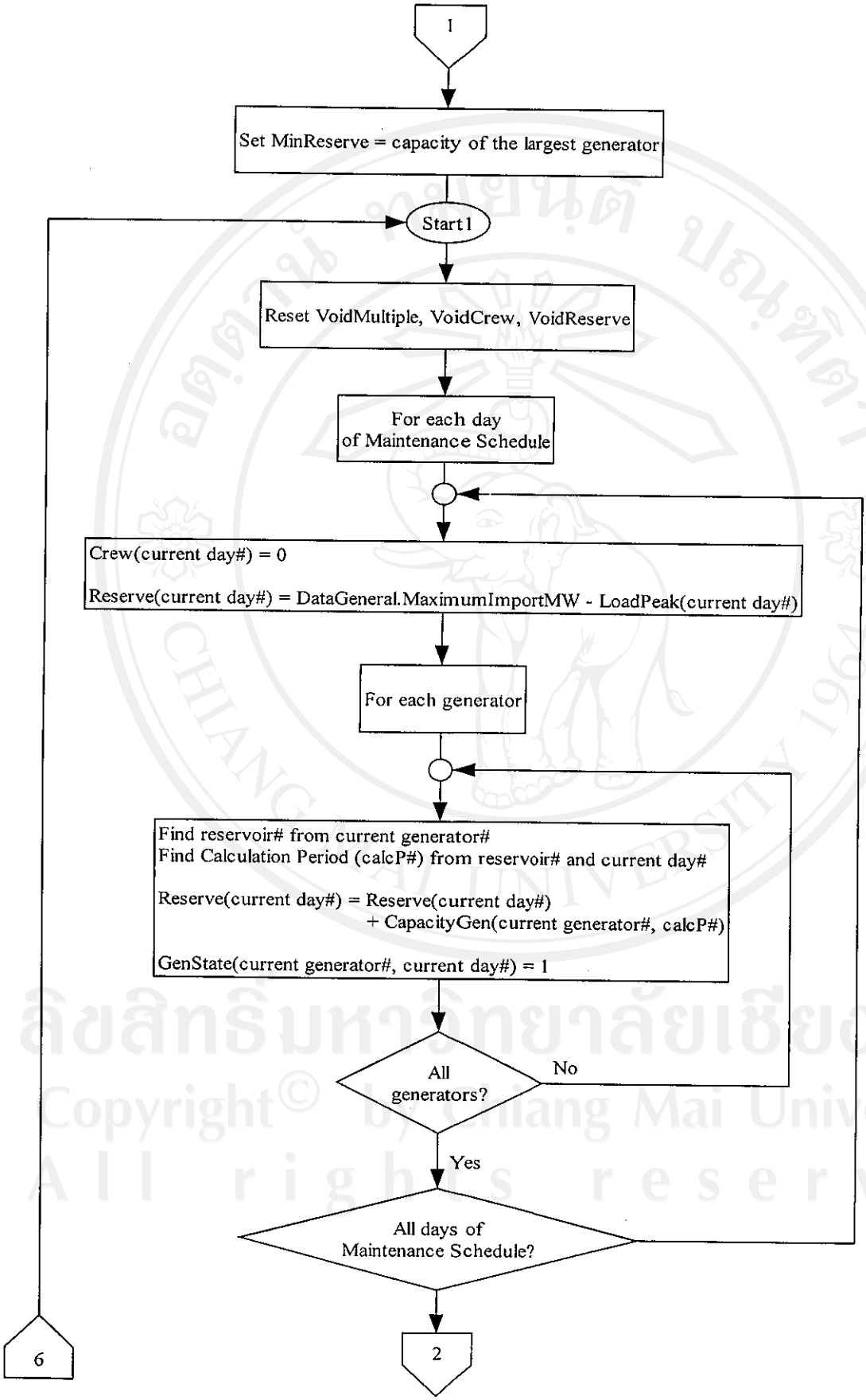

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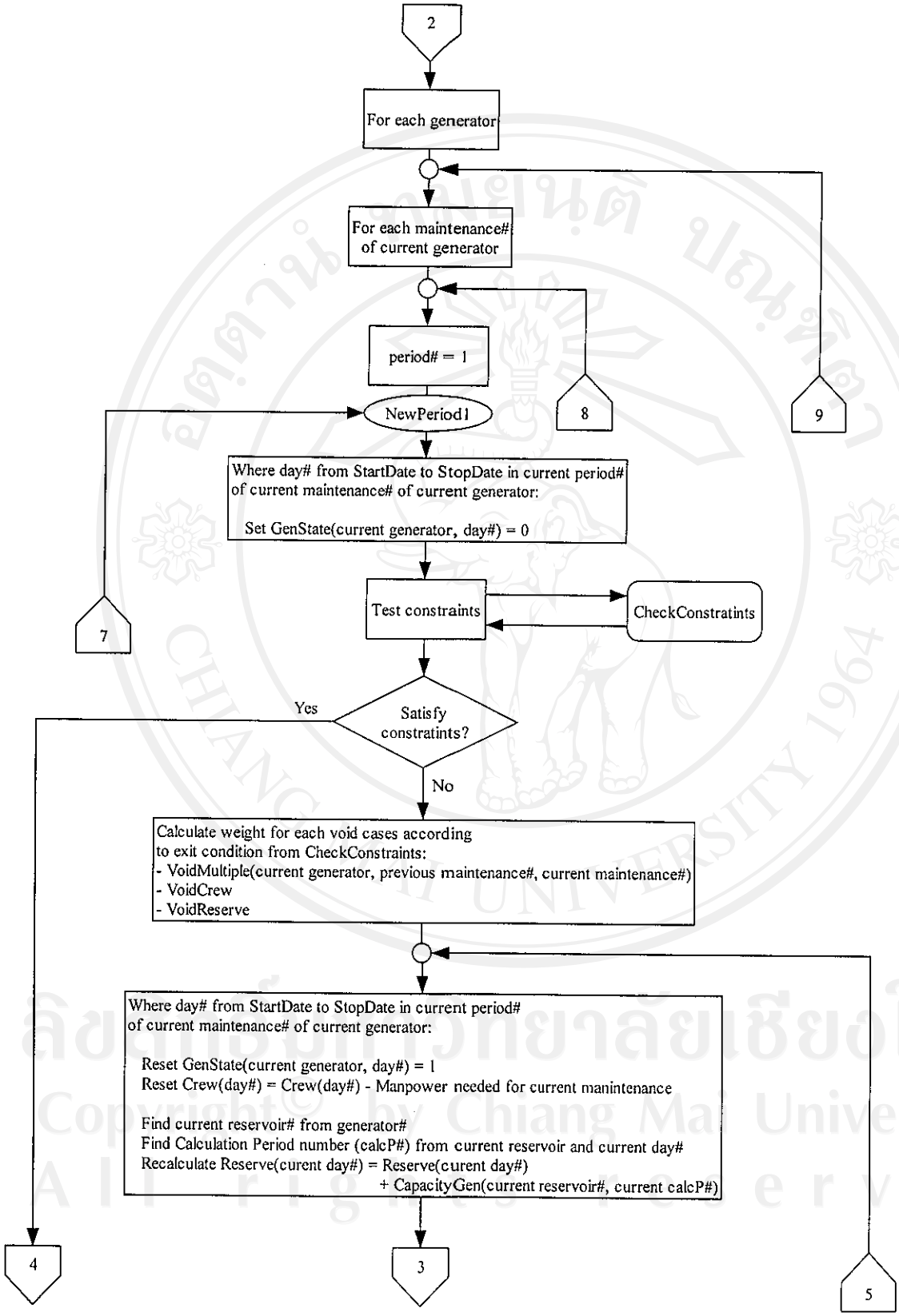

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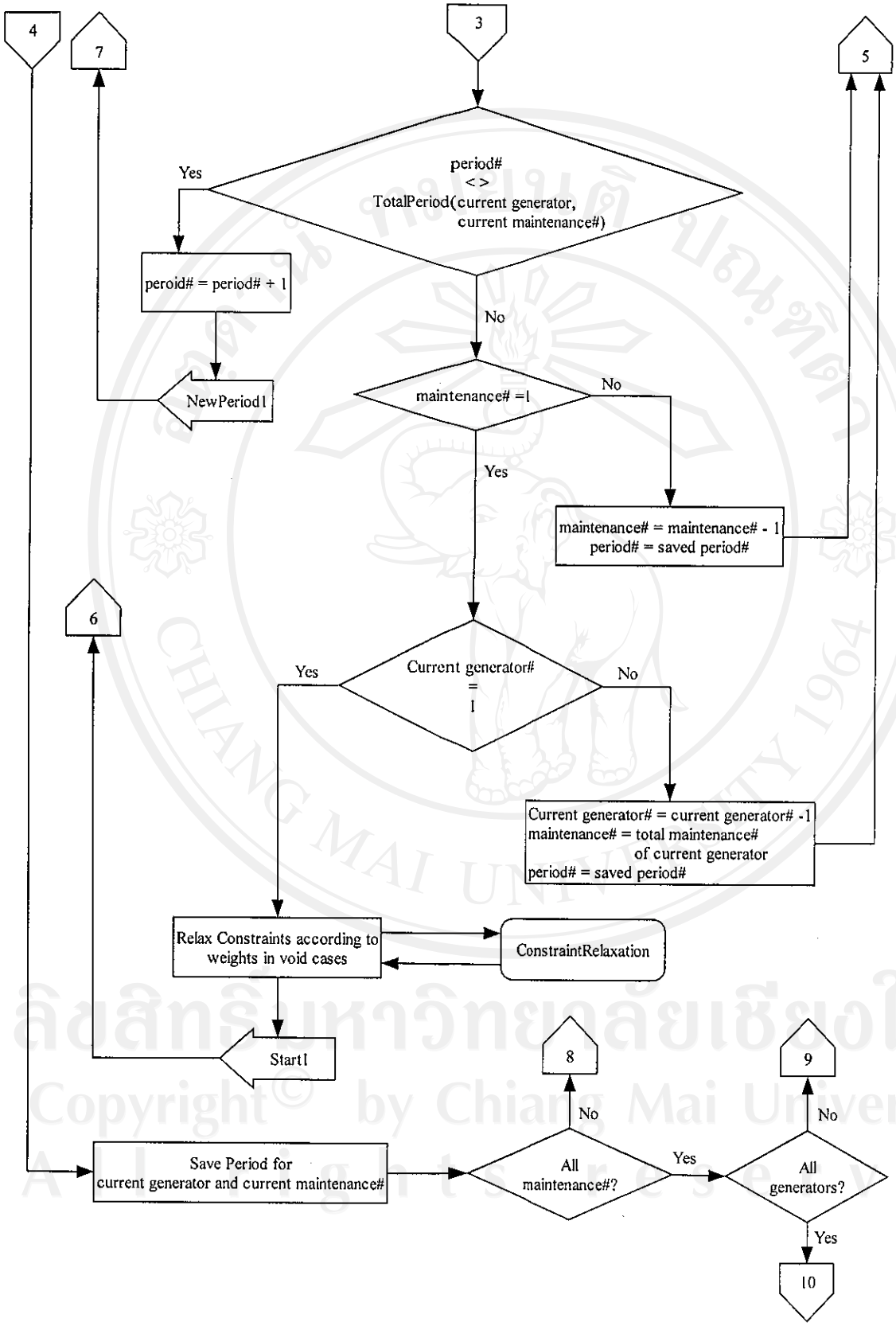

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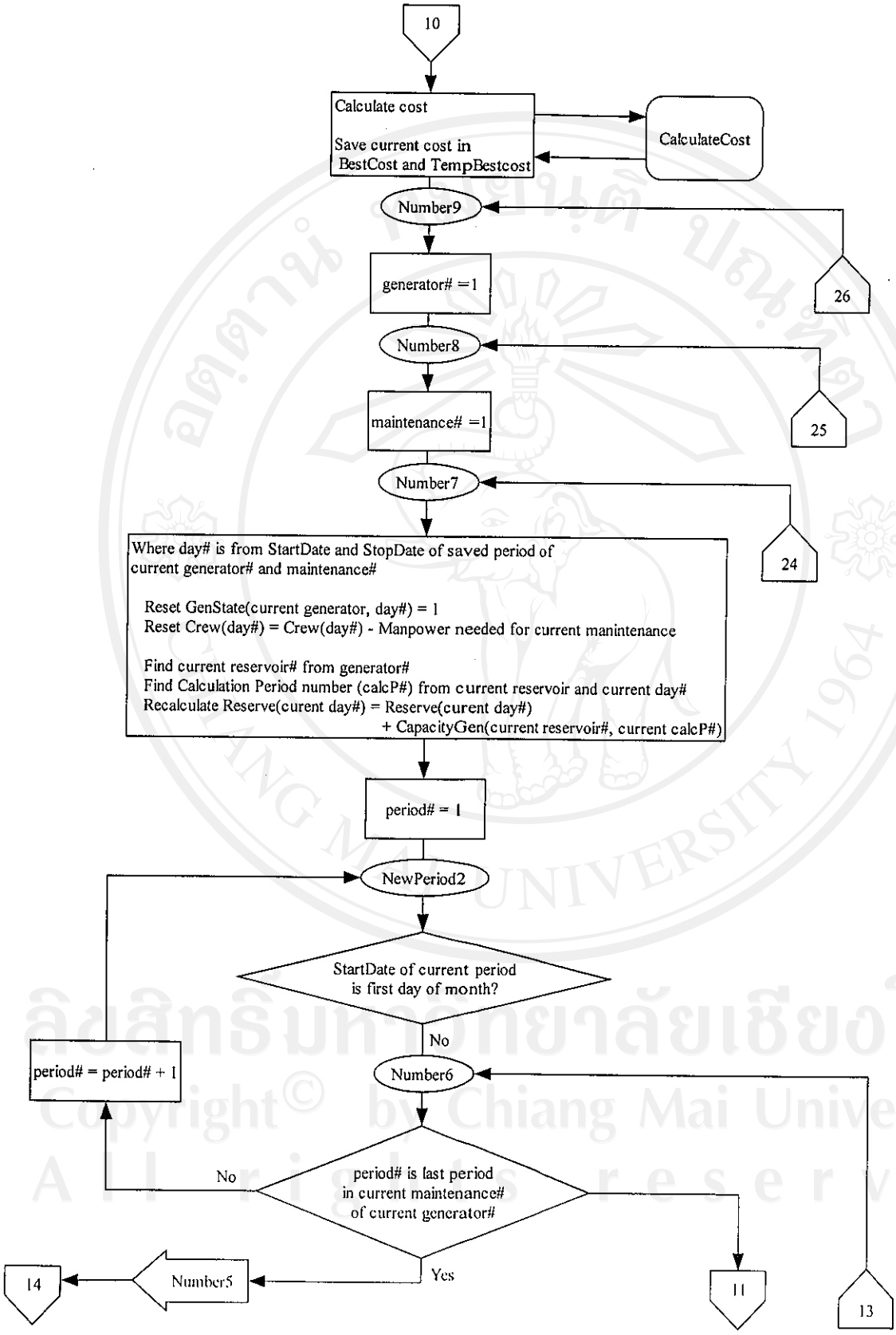

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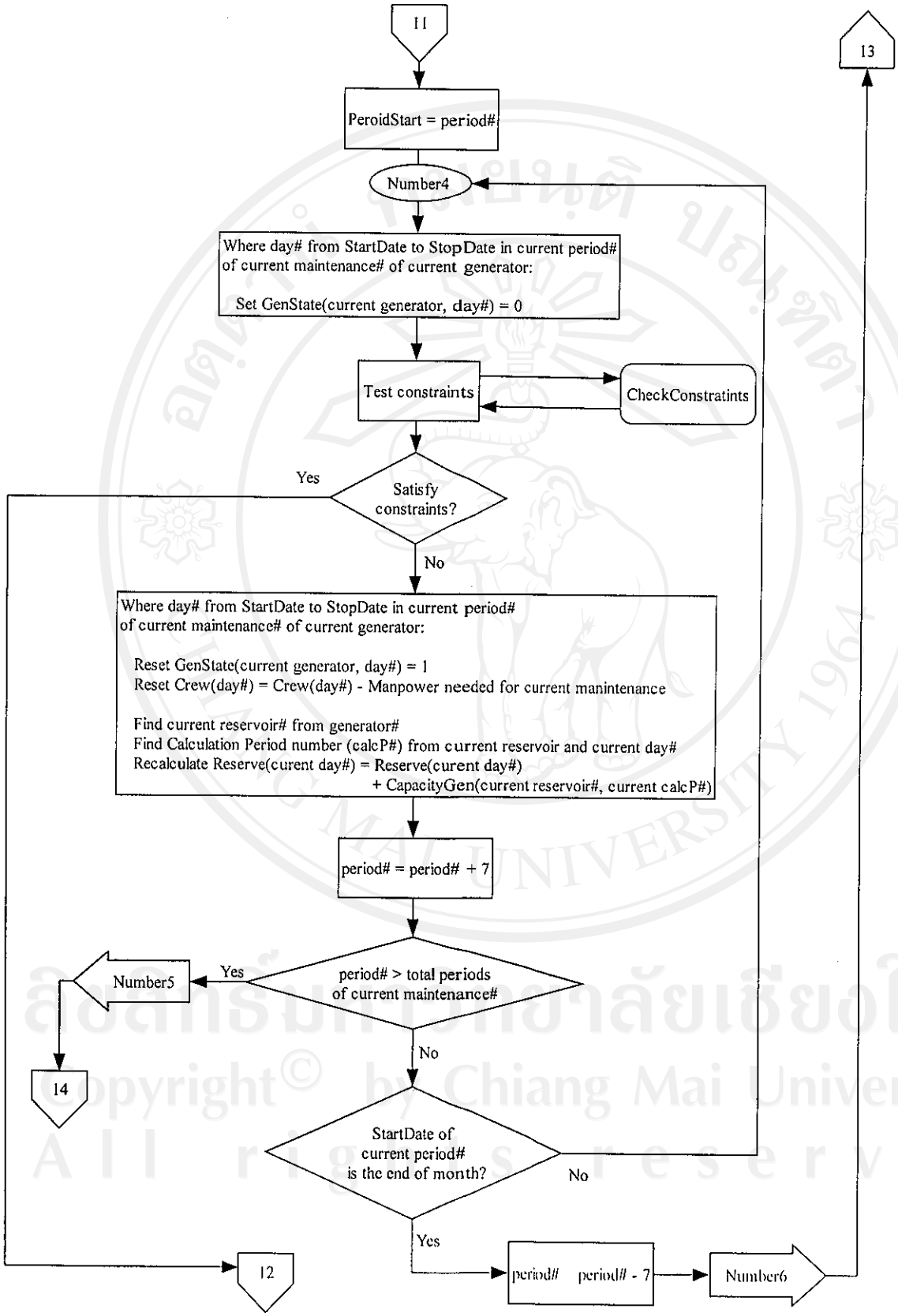

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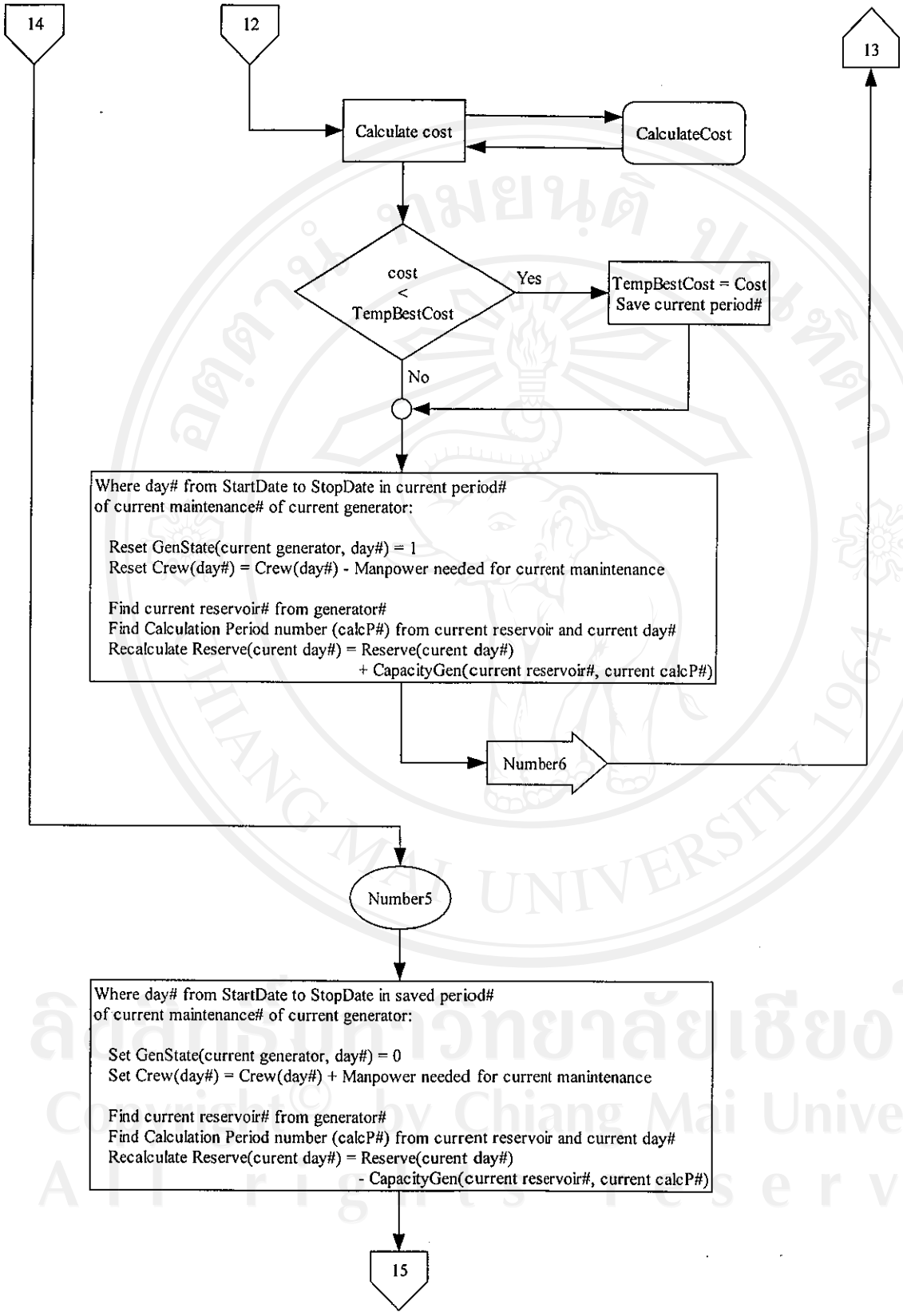

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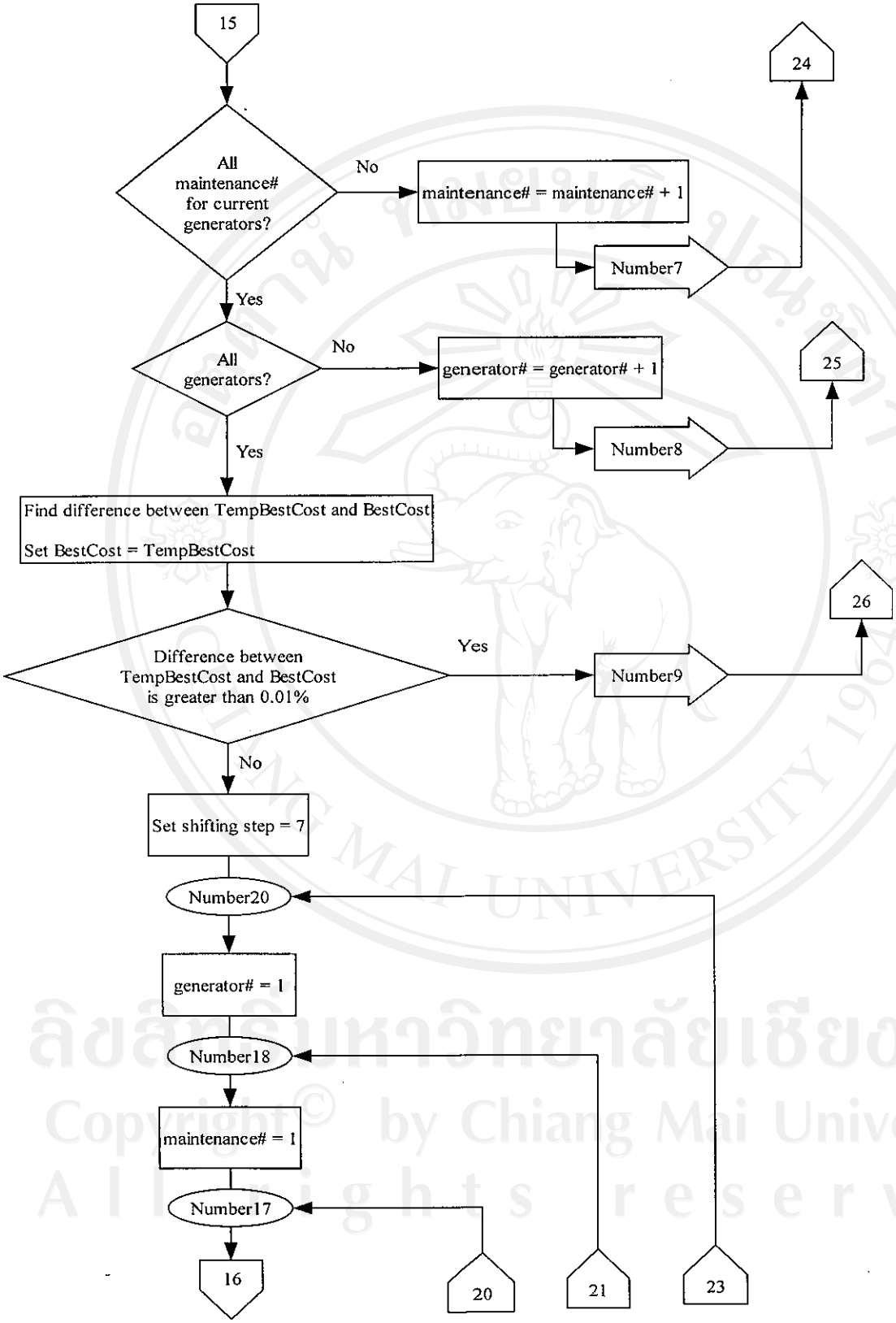

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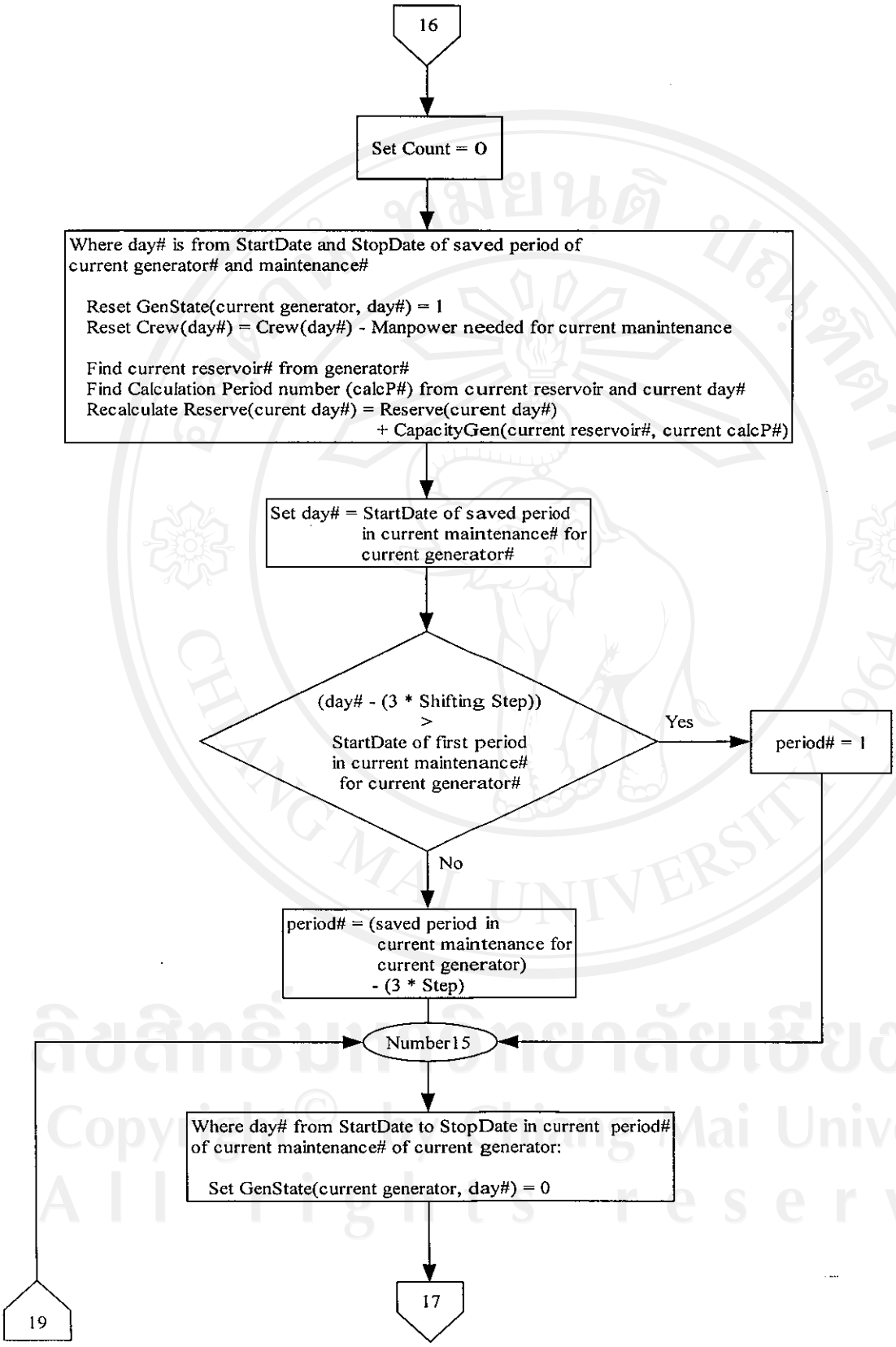

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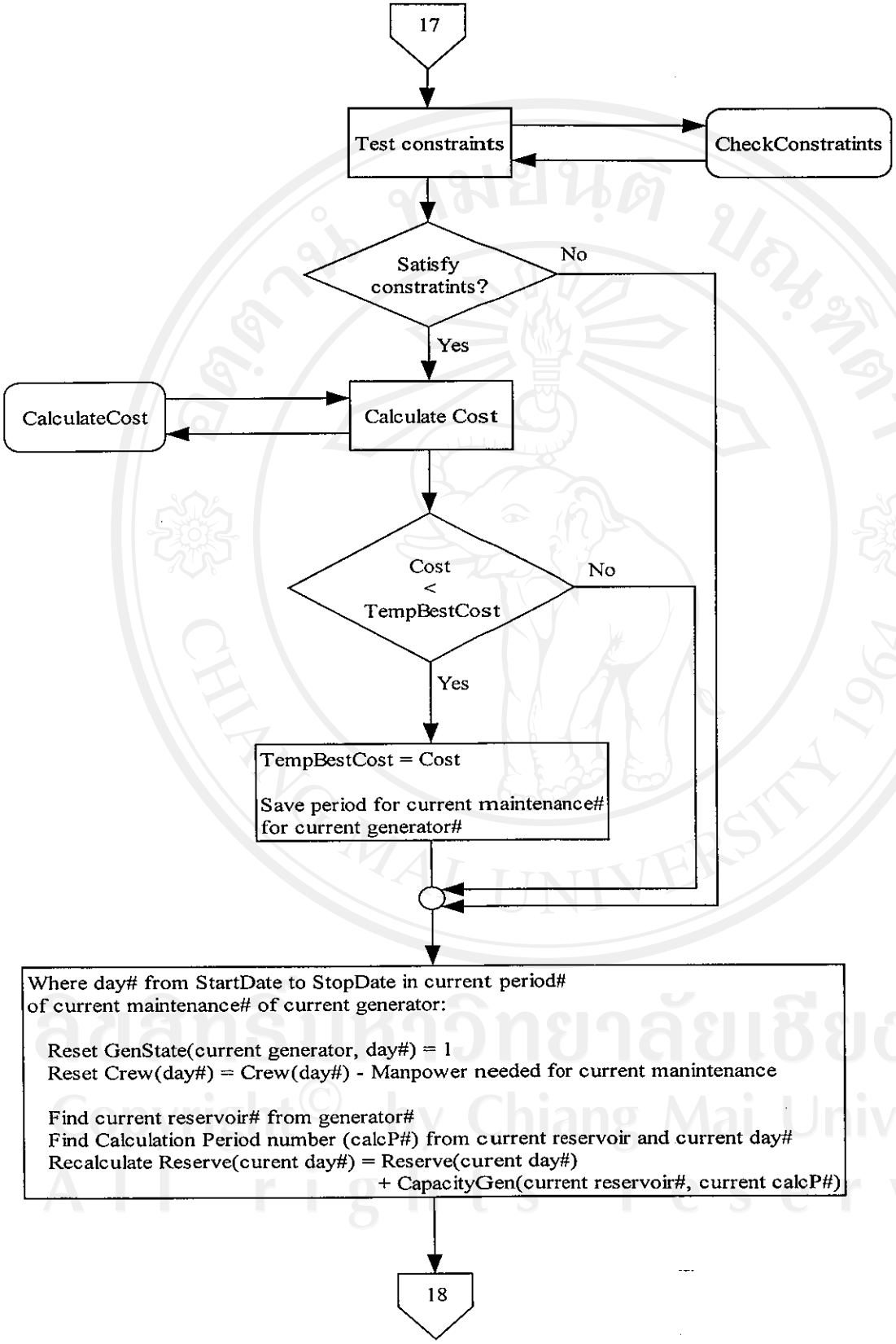

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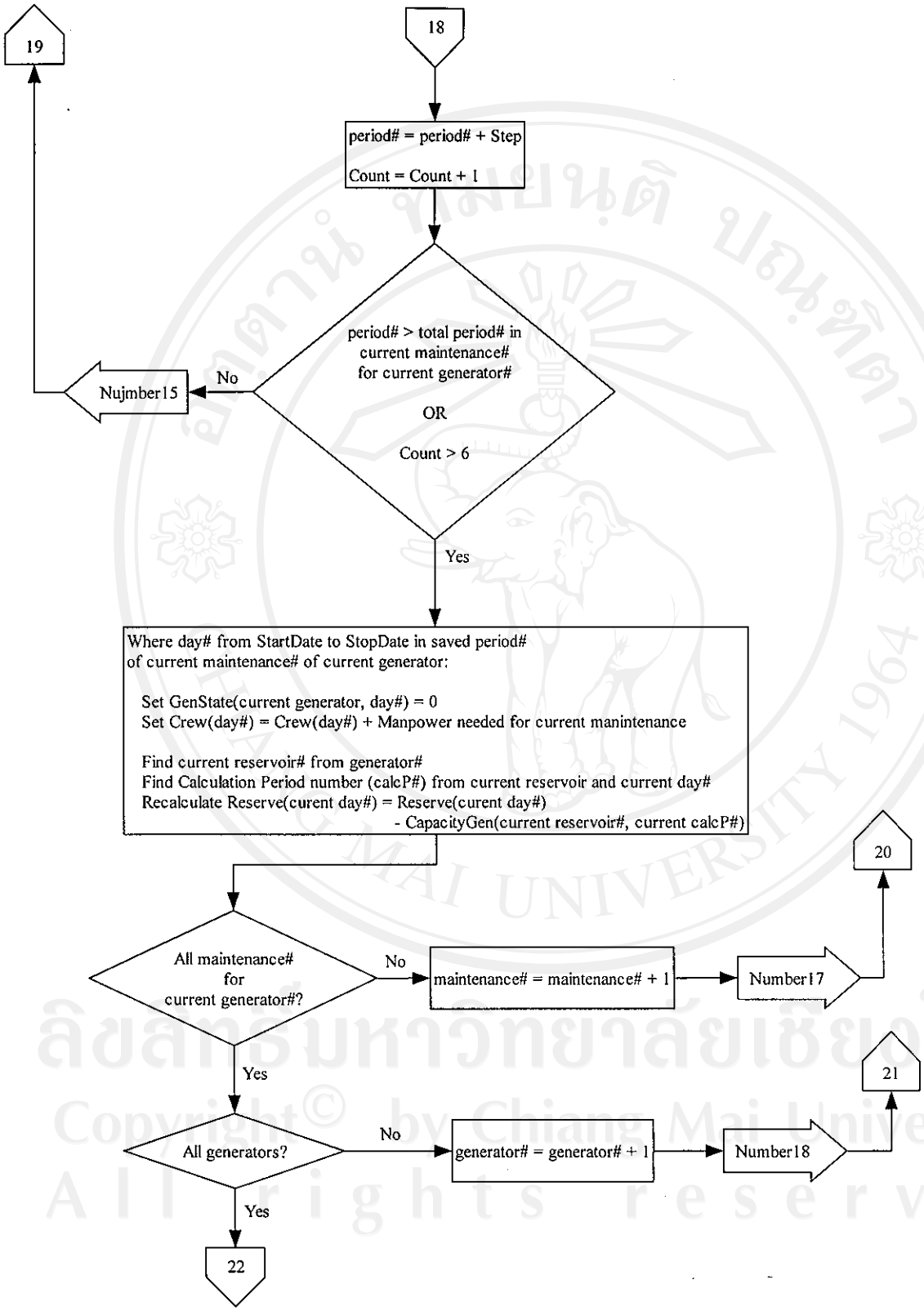

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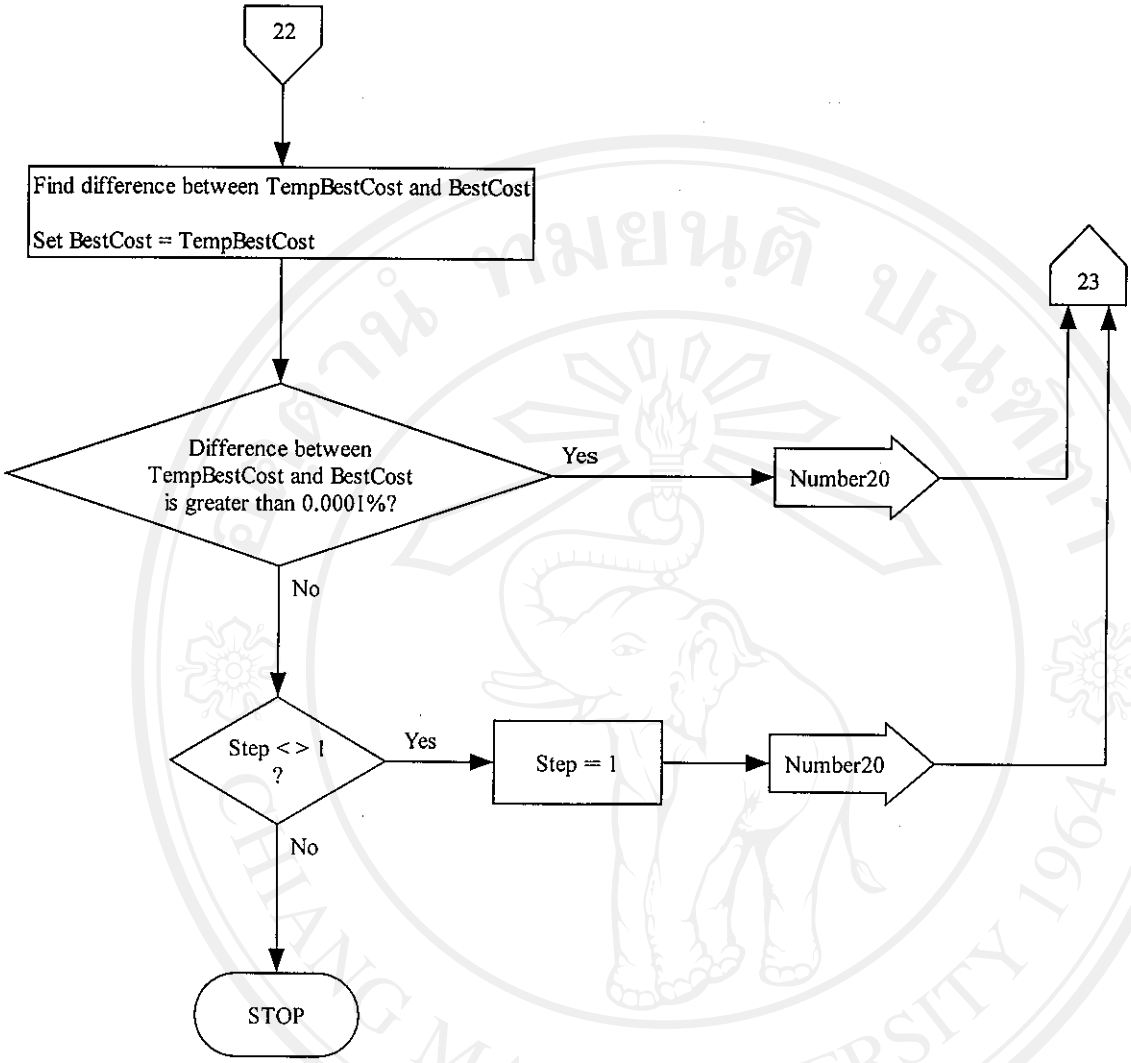

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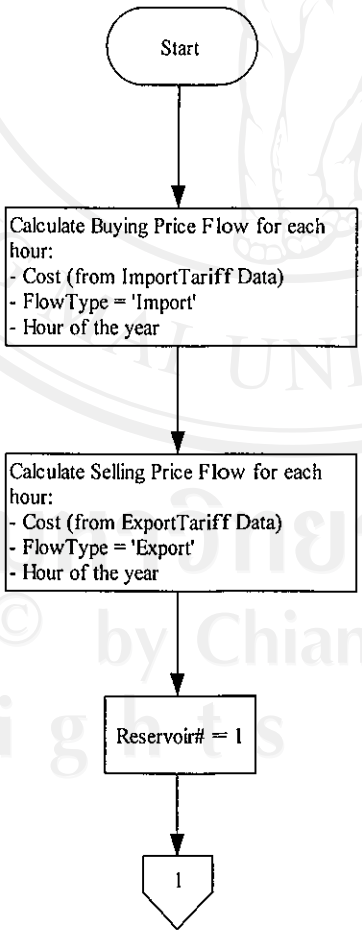
A.6 Calculate Cost

Input:
- DataGeneral
- Generator(generator#)
- Reservoir(reservoir#)
- ImportTariffData
- ExportTariffData
- LoadForecast(day#, hour#)
- LoadPeak(day#)
- MaintenanceInfo(generator#)
- InflowForecast(reservoir#)
- MaxLimit(reservoir#, month#)
- MinLimit(reservoir#, month#)
- Average(reservoir#, month#)
- CalcPeriod(reservoir#, month#)
- TotalCalcPeriod(reservoir#)
- Release(reservoir#, month#)
- CapacityGen(generator#, calcP#)
- WaterRate(generator#, month#)
- Flow(hour#)
- LoadTemp(hour#)

Output:
- Revenue

LocalVariable:
- SellPrice(hour#)
- BuyPrice(hour#)
- XLoadTemp(hour#)
- XLoadTemp1(hour#)
- ReleaseAcc(1 To 3, 1 To 12)
- ReleaseAccTemp
- ReleaseTemp
- MaxRelease(month#)
- MinRelease(month#)
- WaterEnd(month#)
- OrderHour(hour#)
- OrderHour1(hour#)
- OrderGen(1 To 10)
- PowerGen()
- WaterRateGen()
- Revenue
- Spacing
- SpillTemp As Double



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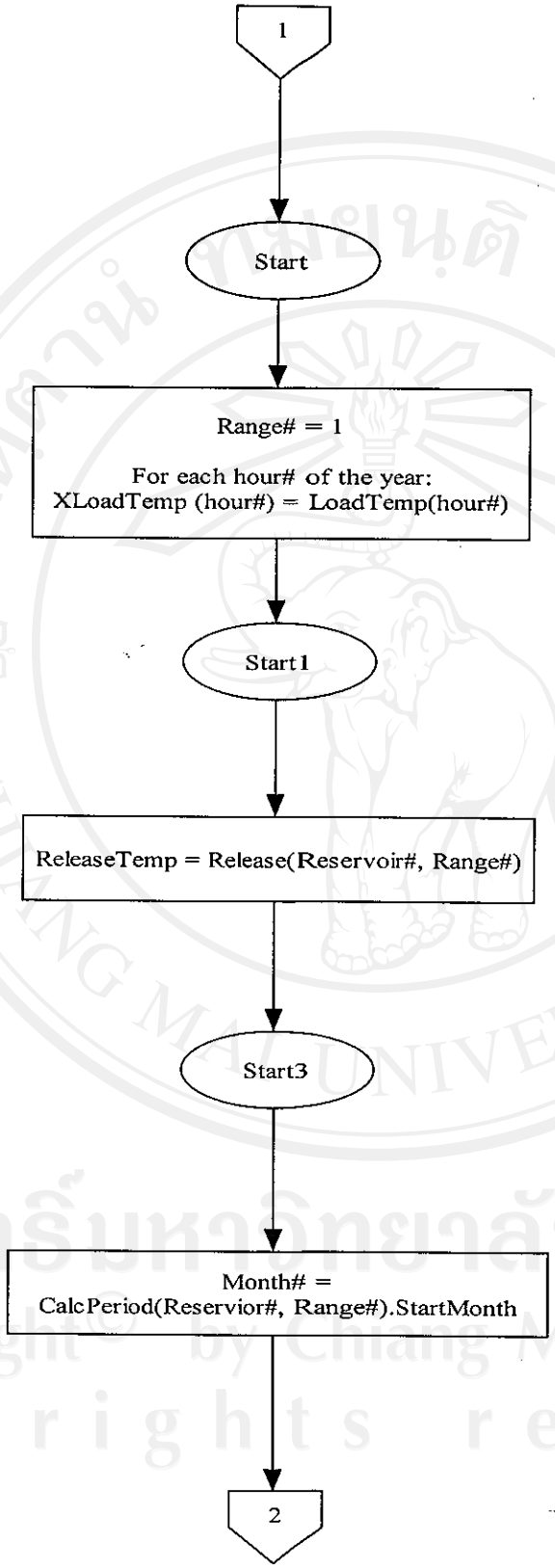

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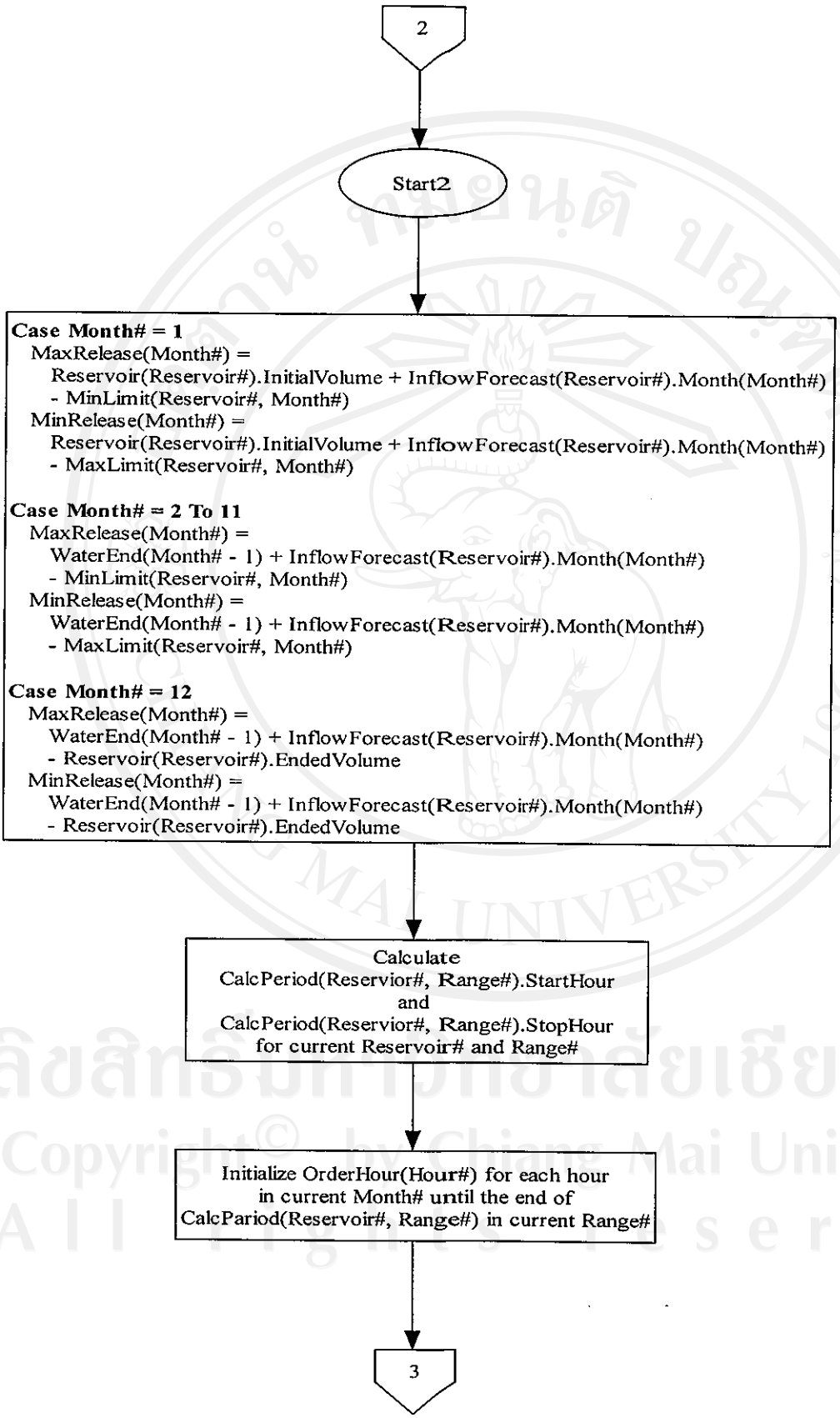

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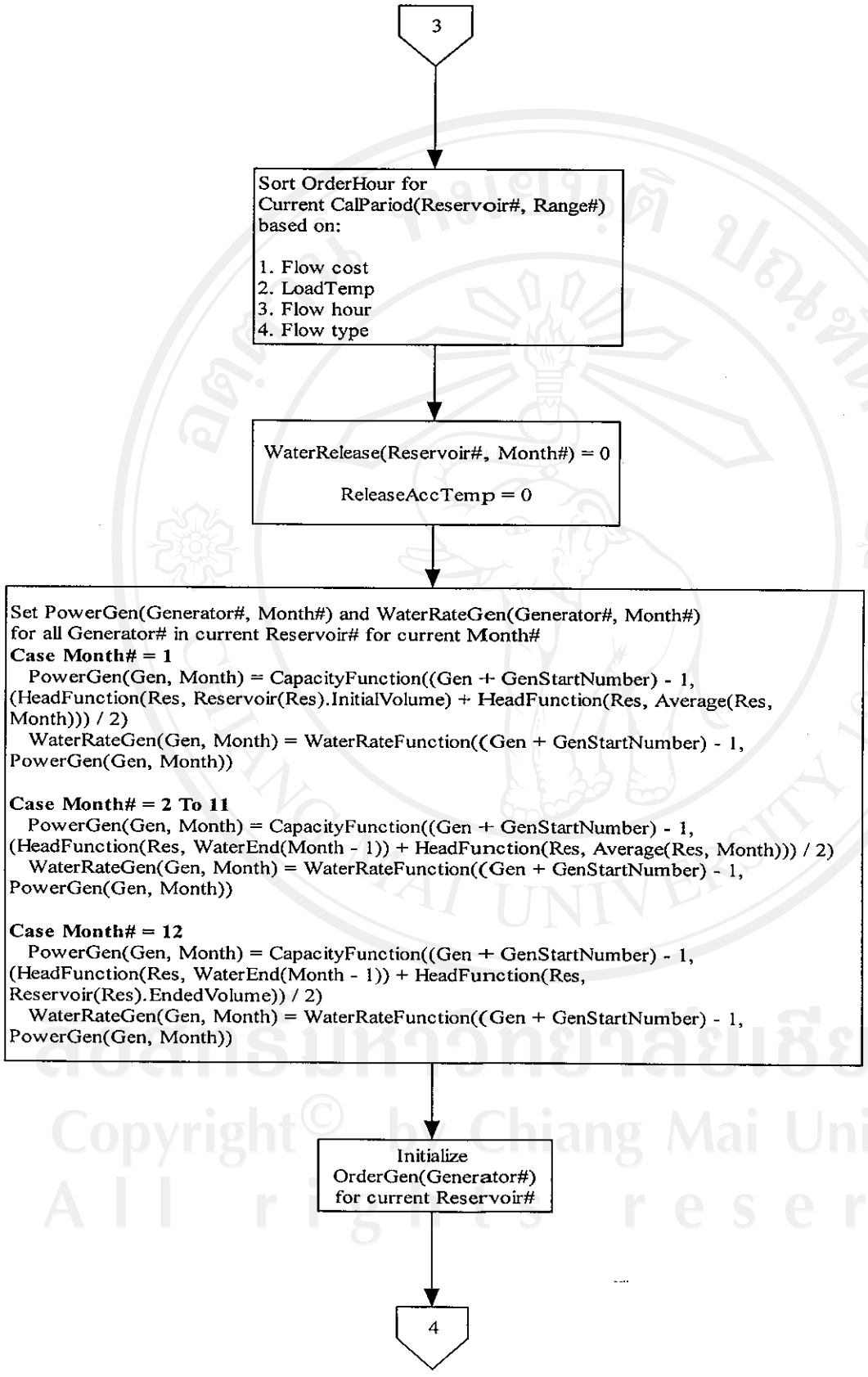

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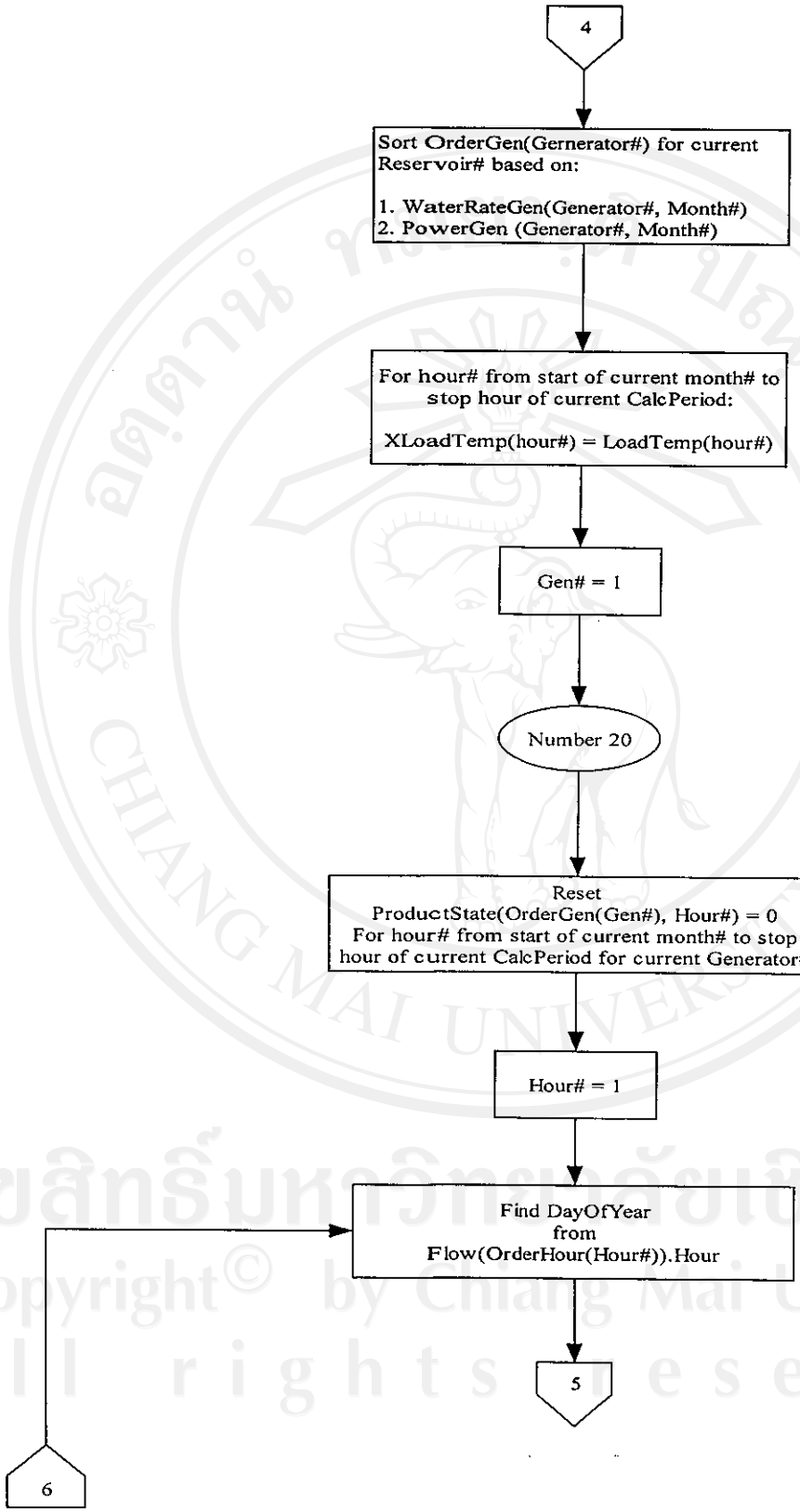

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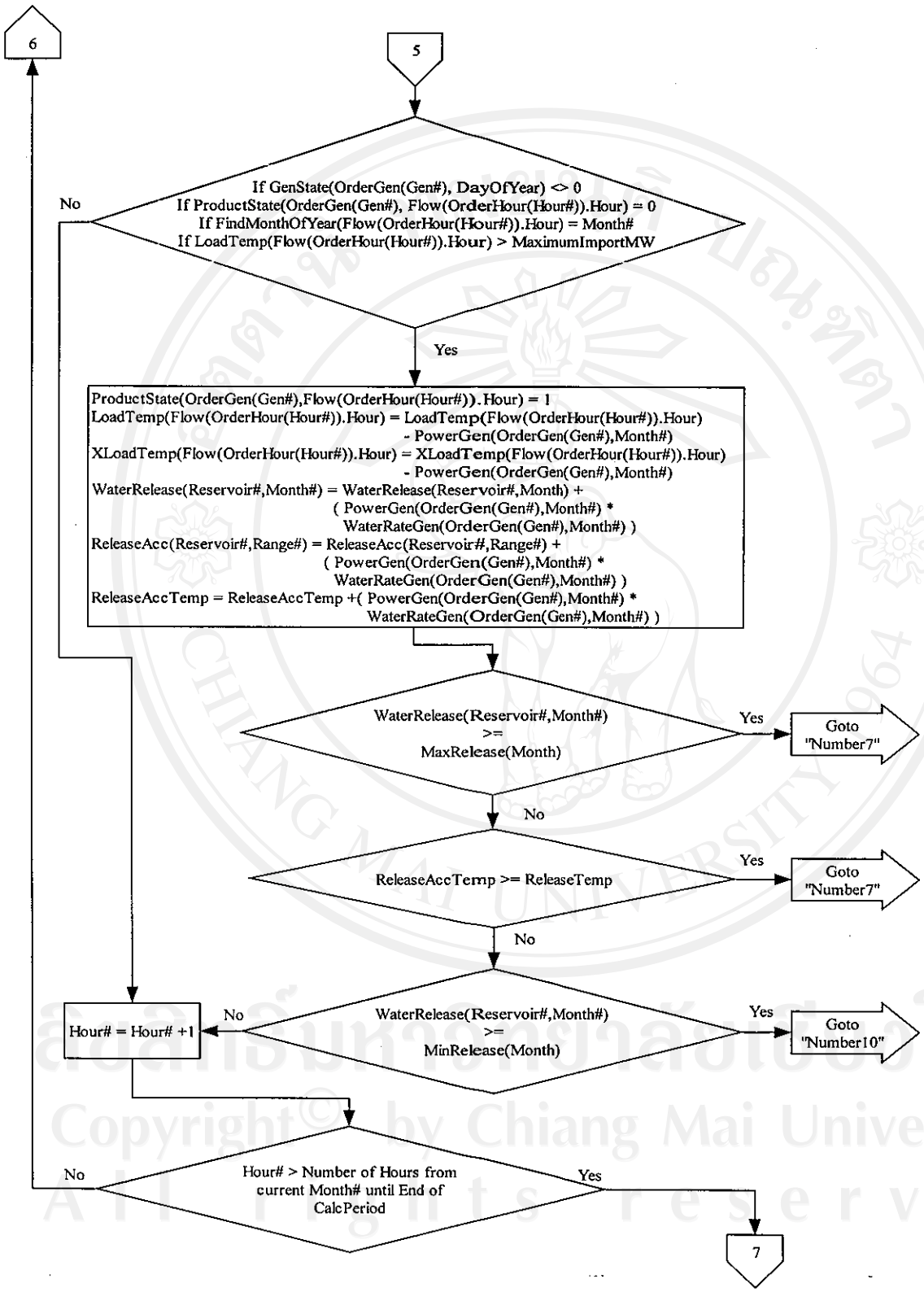

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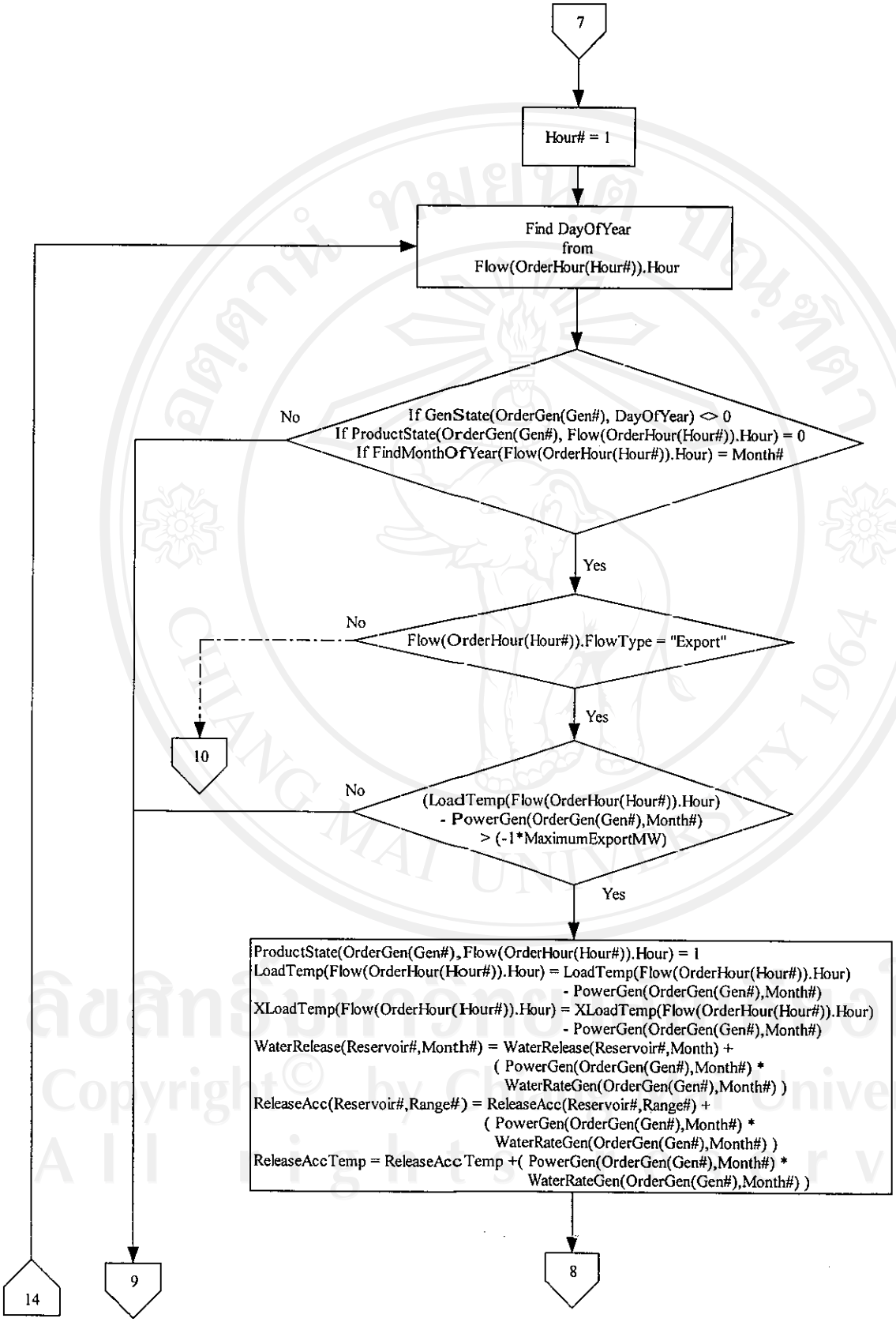

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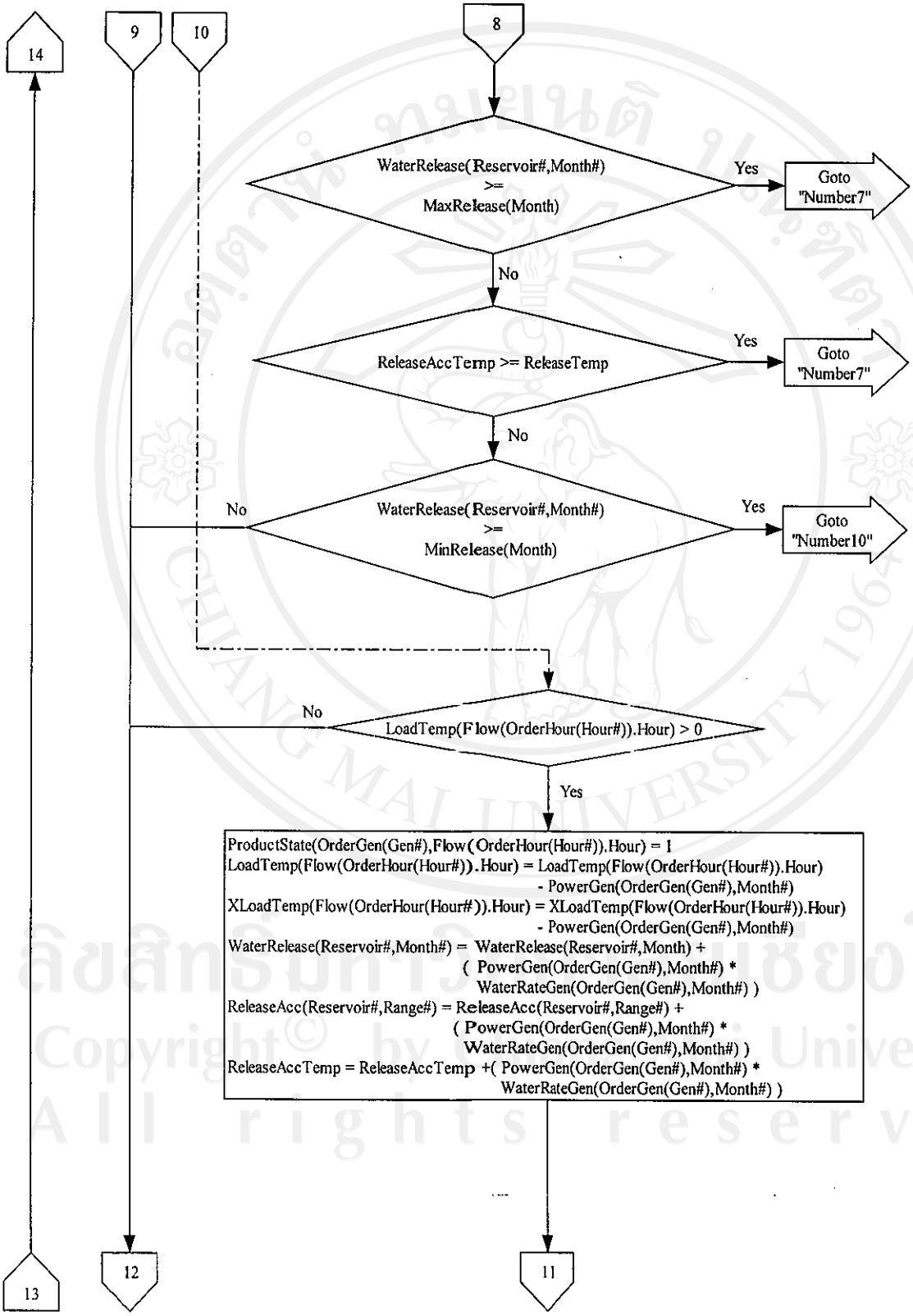

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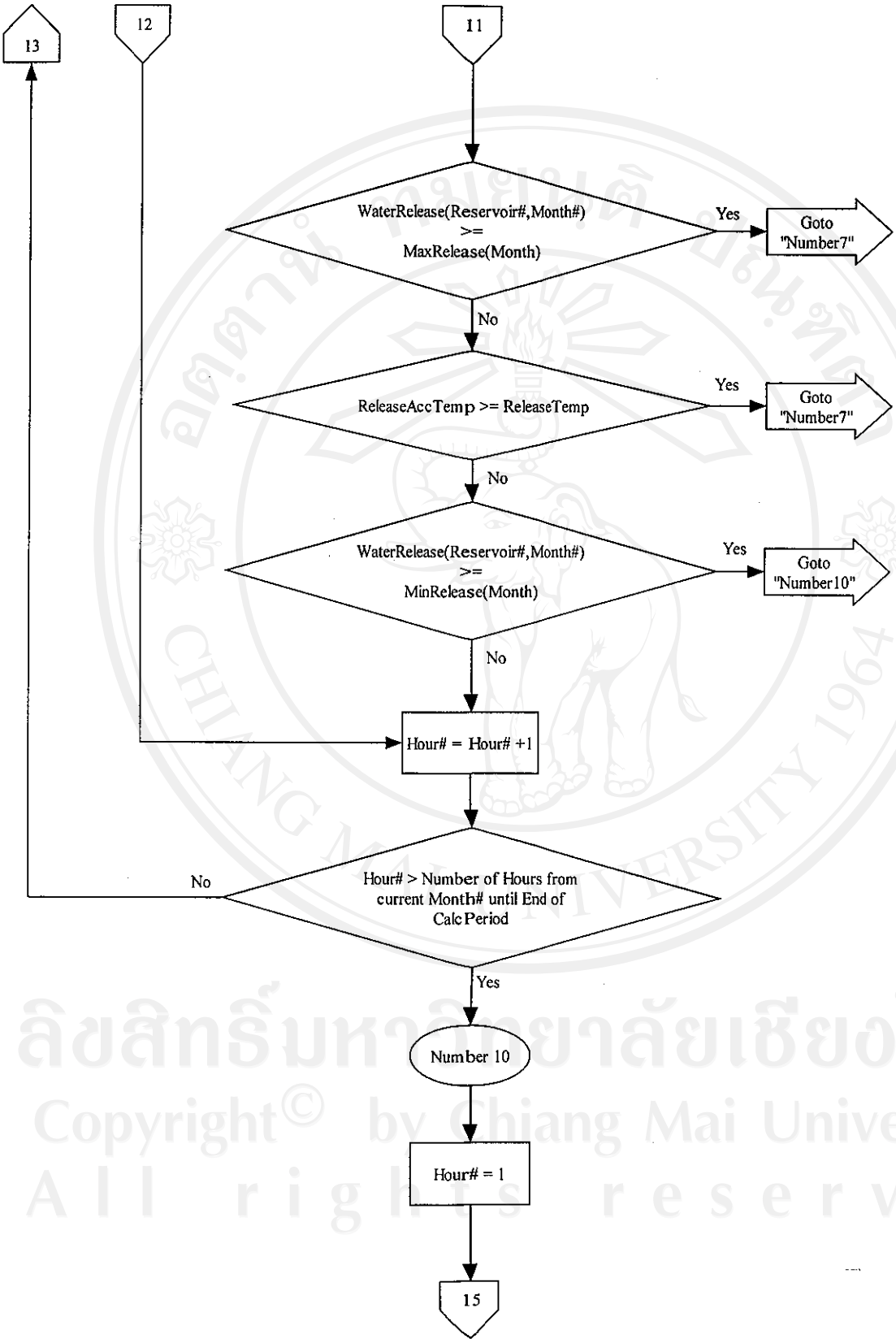

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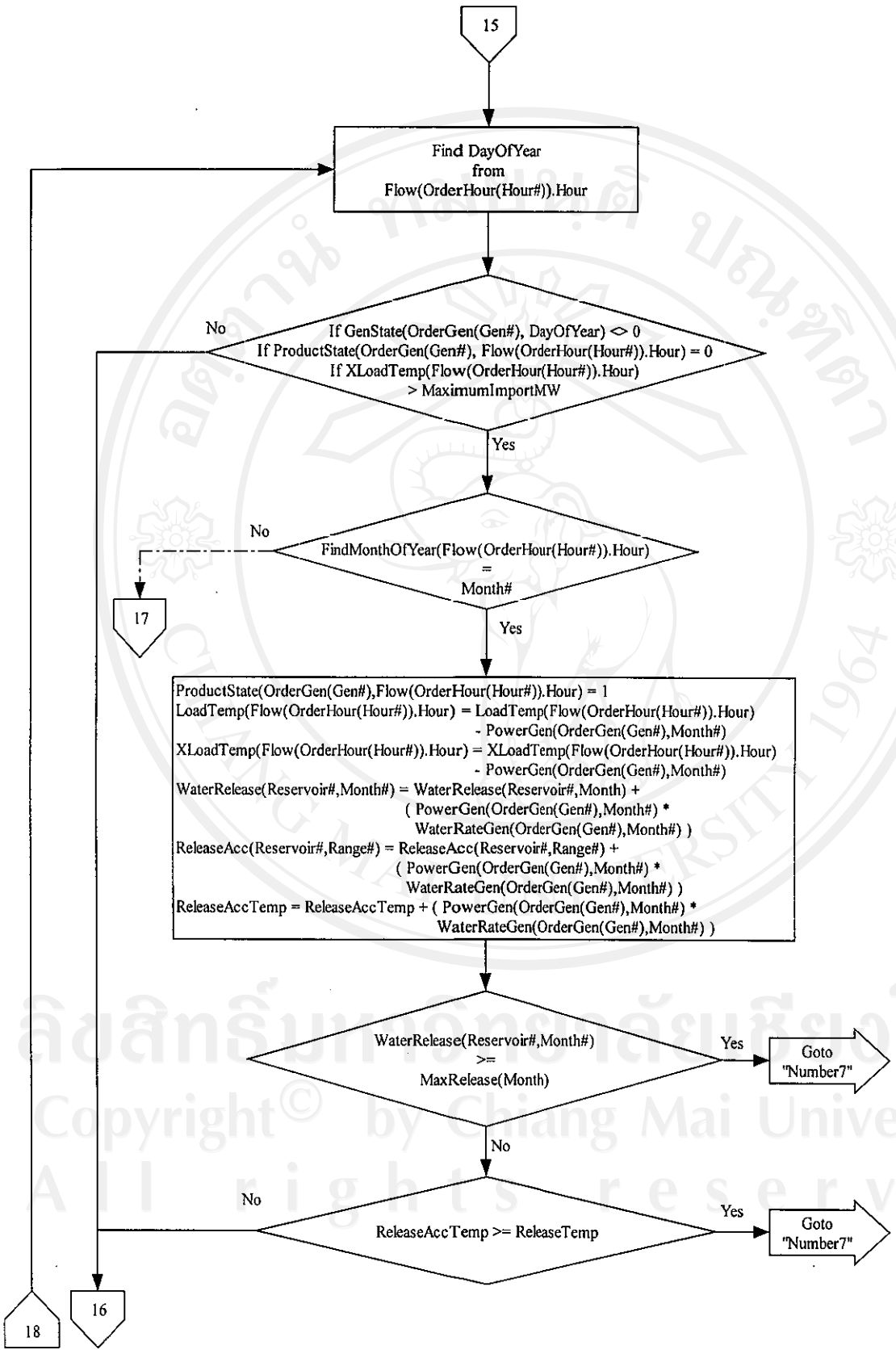

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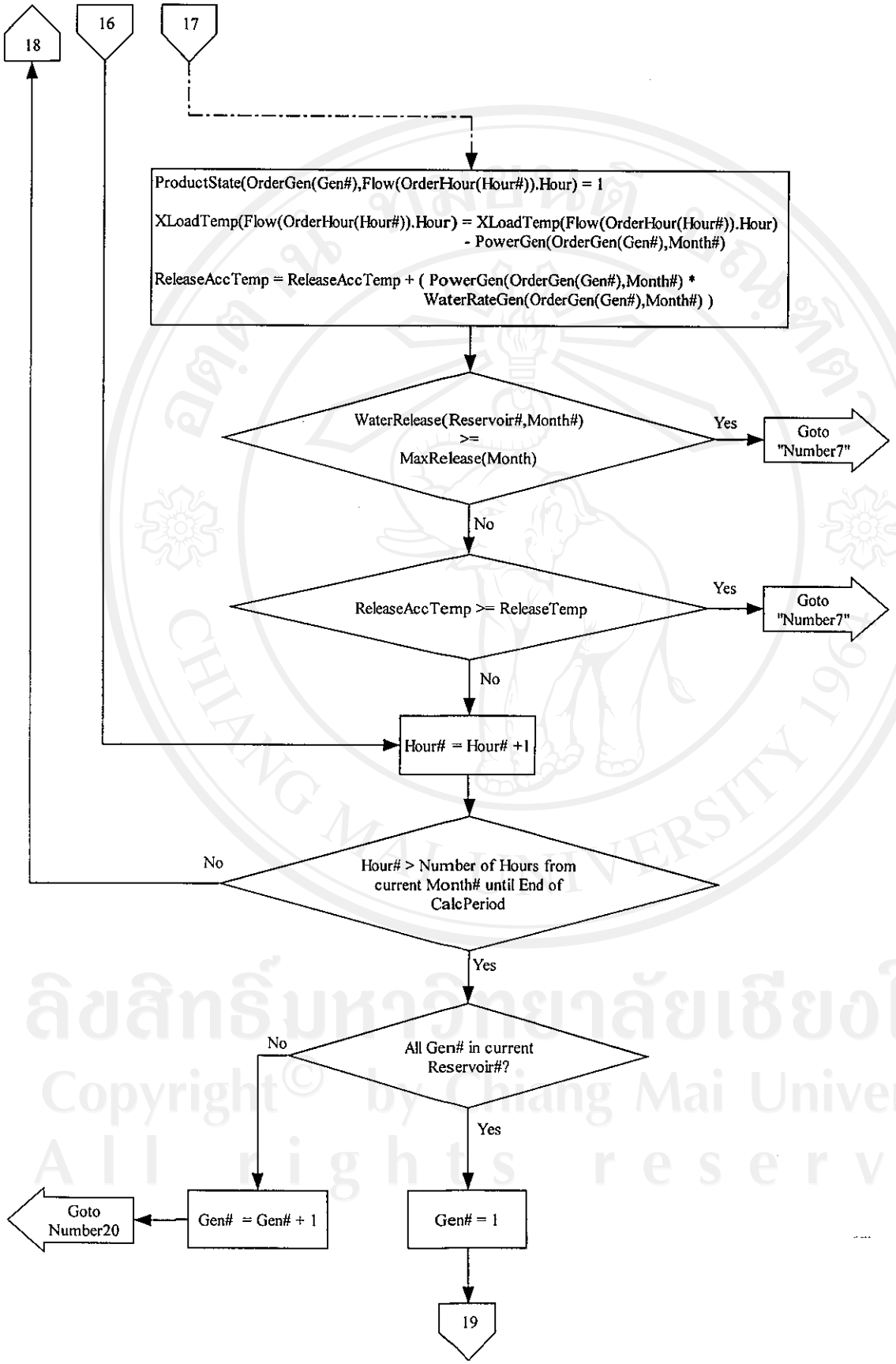

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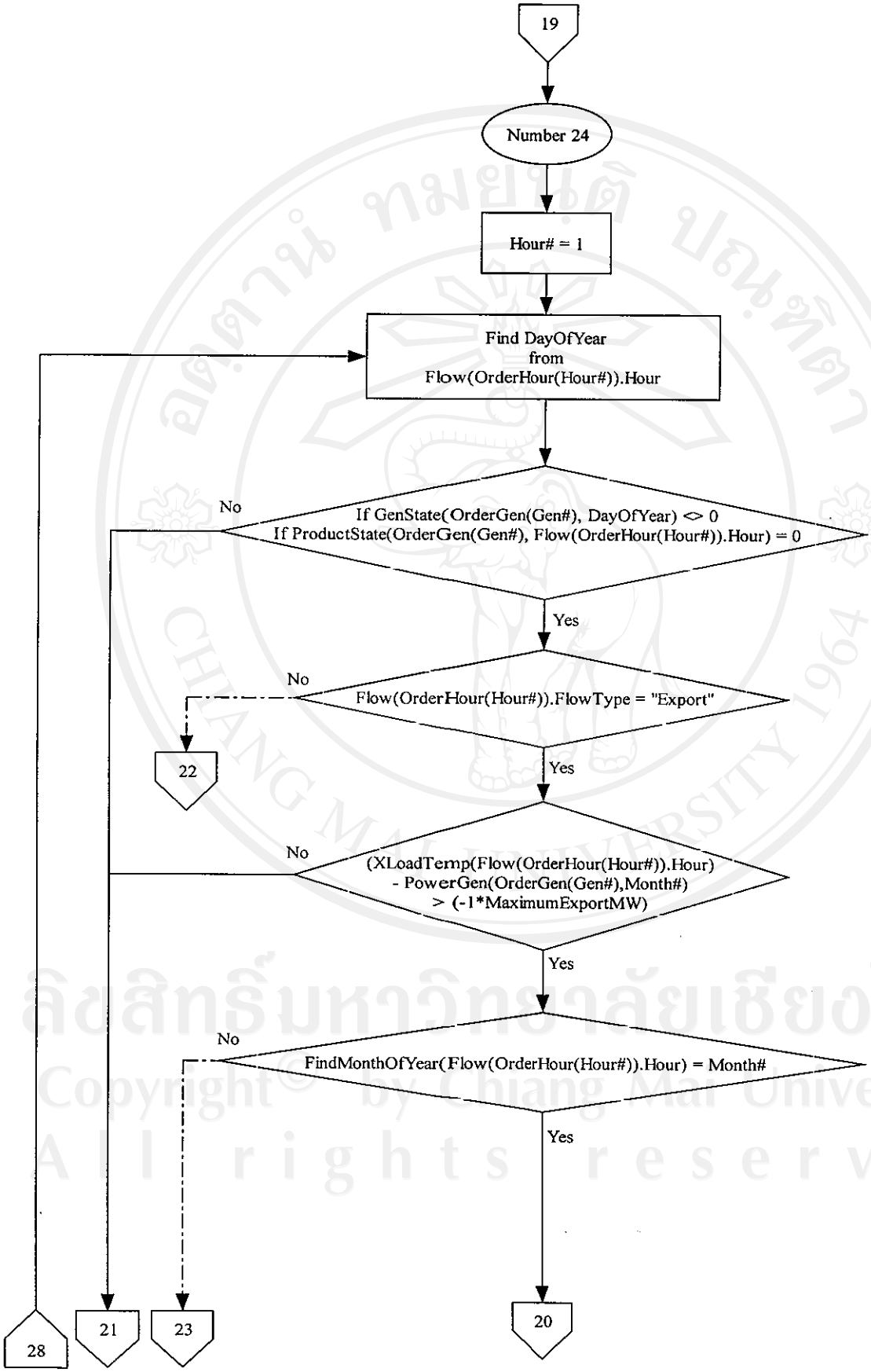

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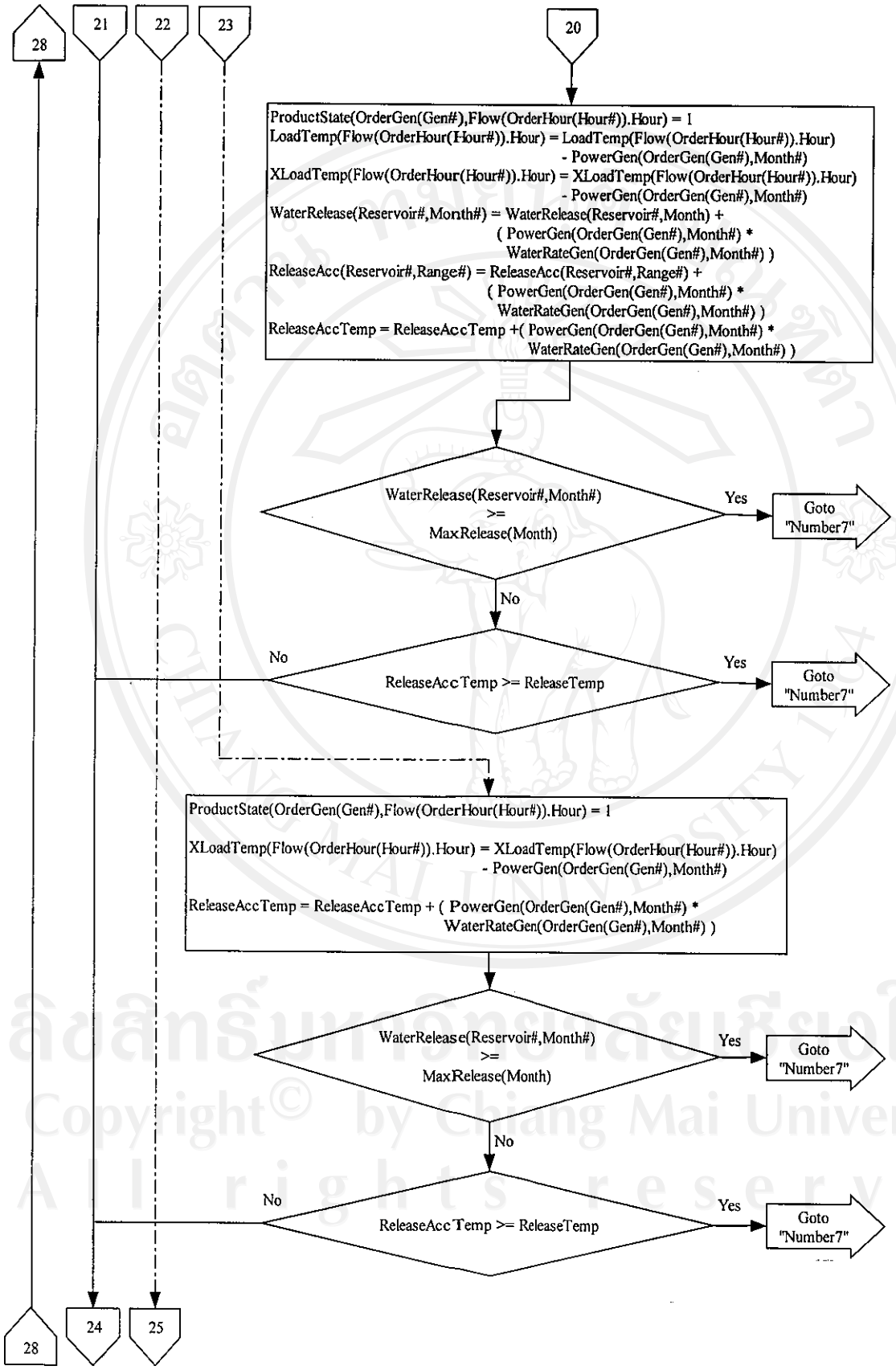

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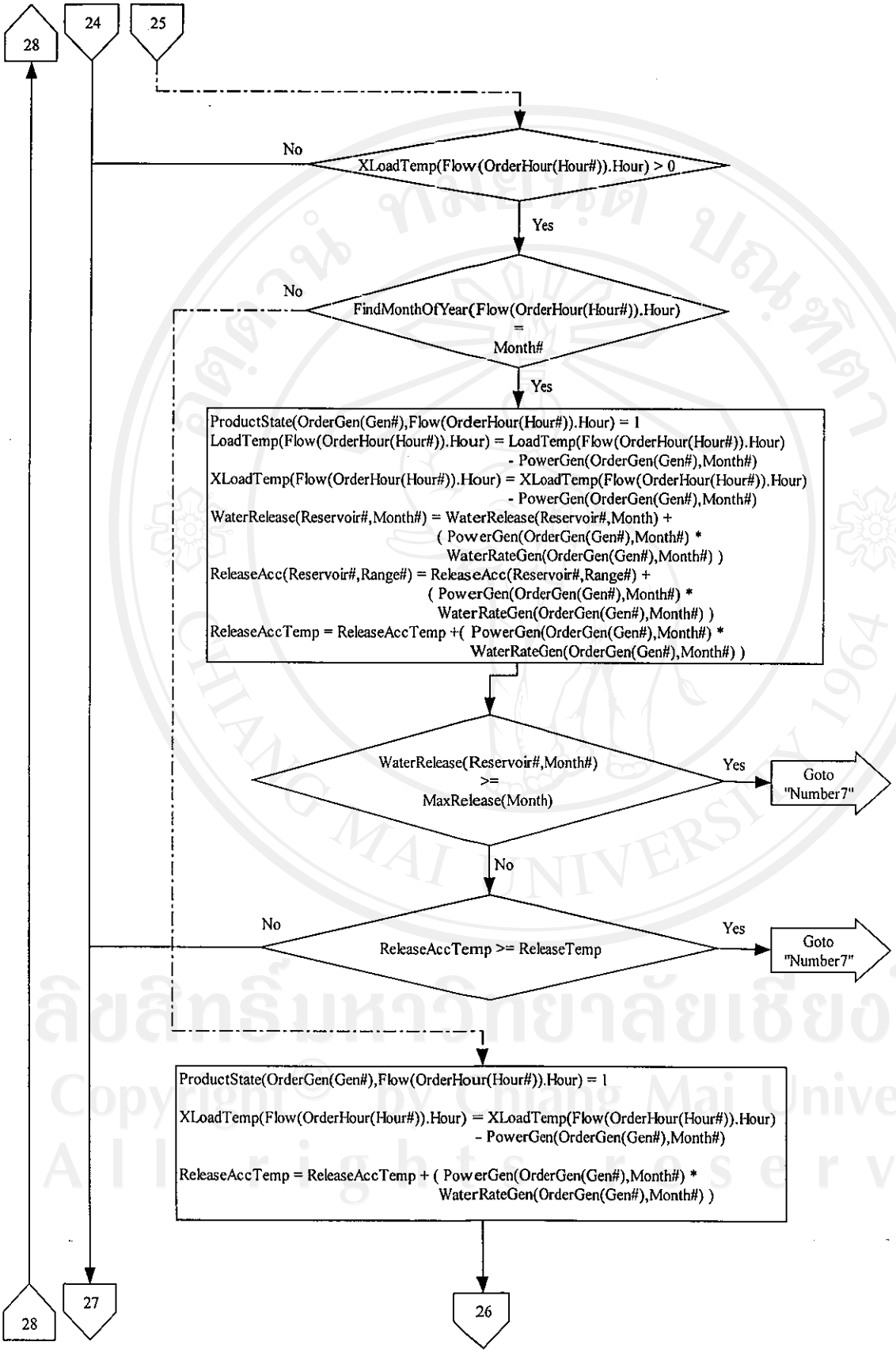

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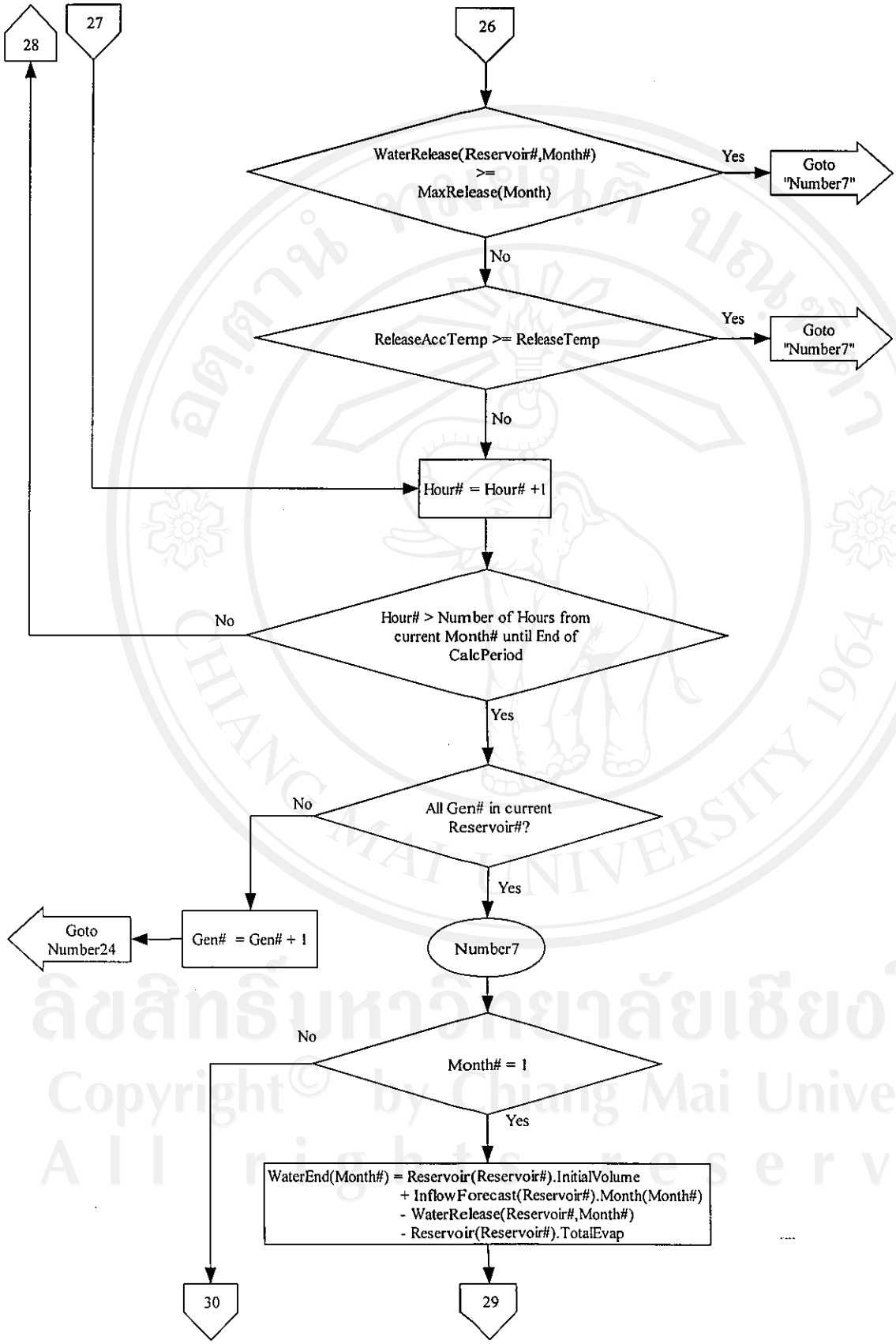

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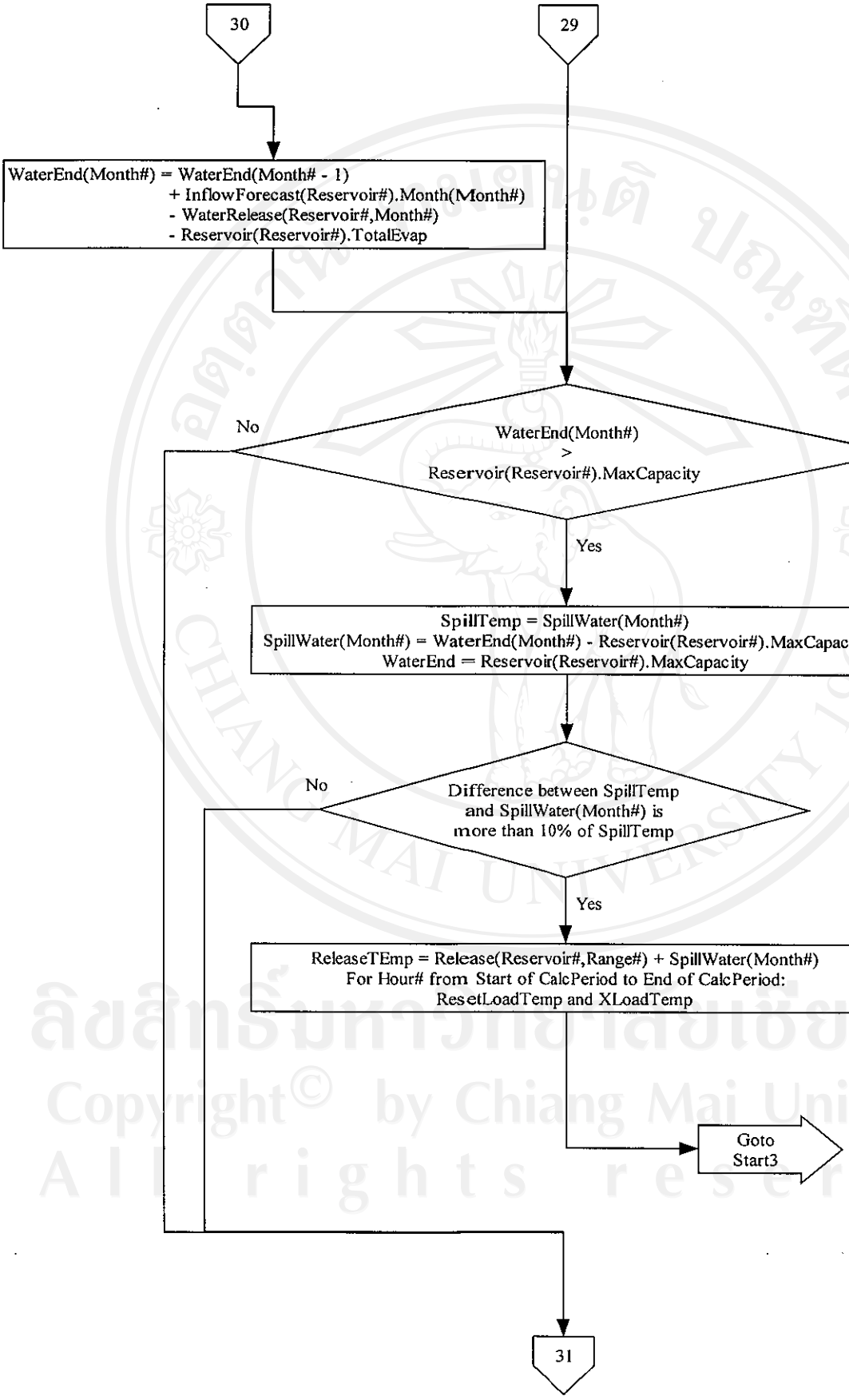

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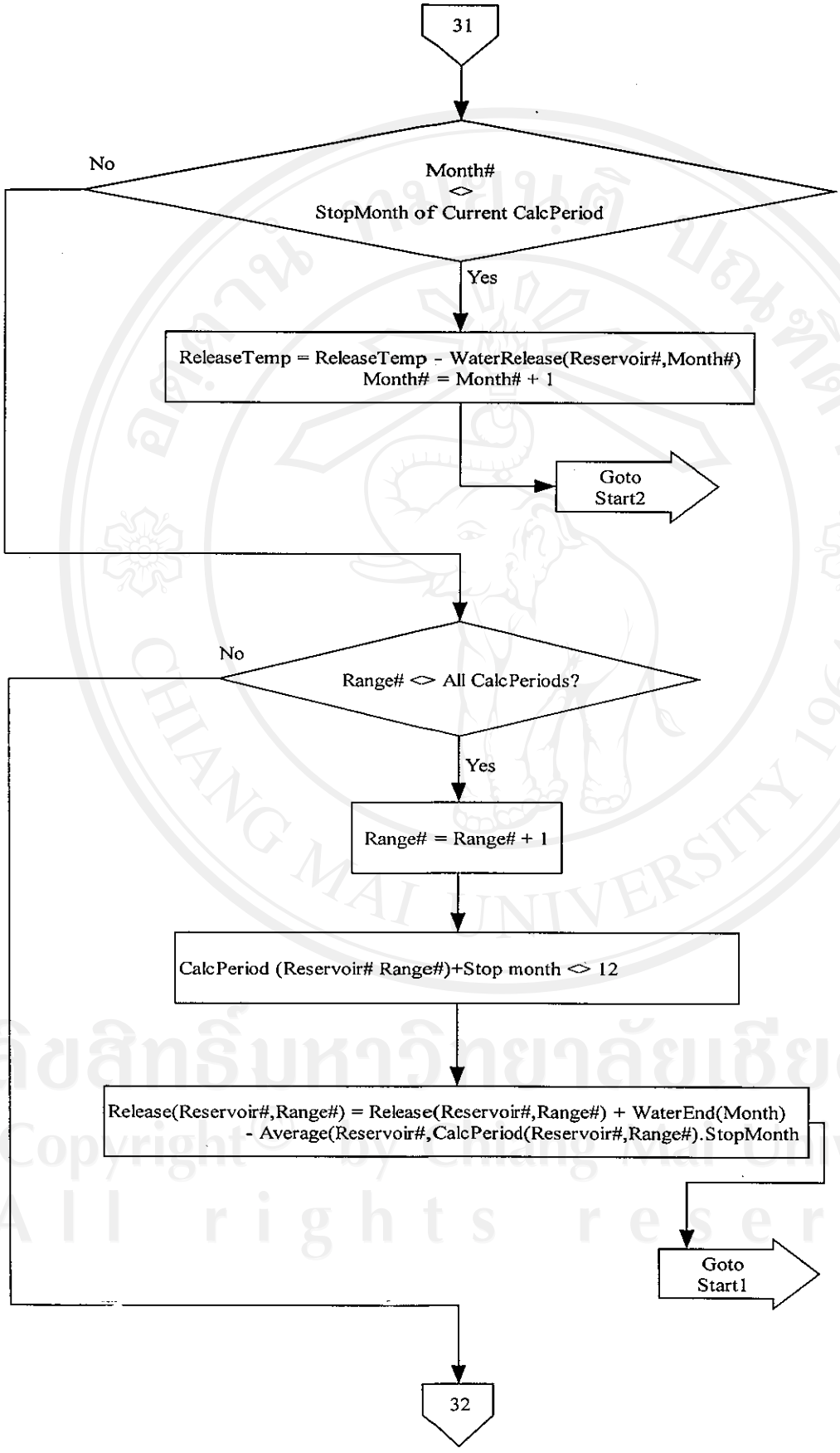

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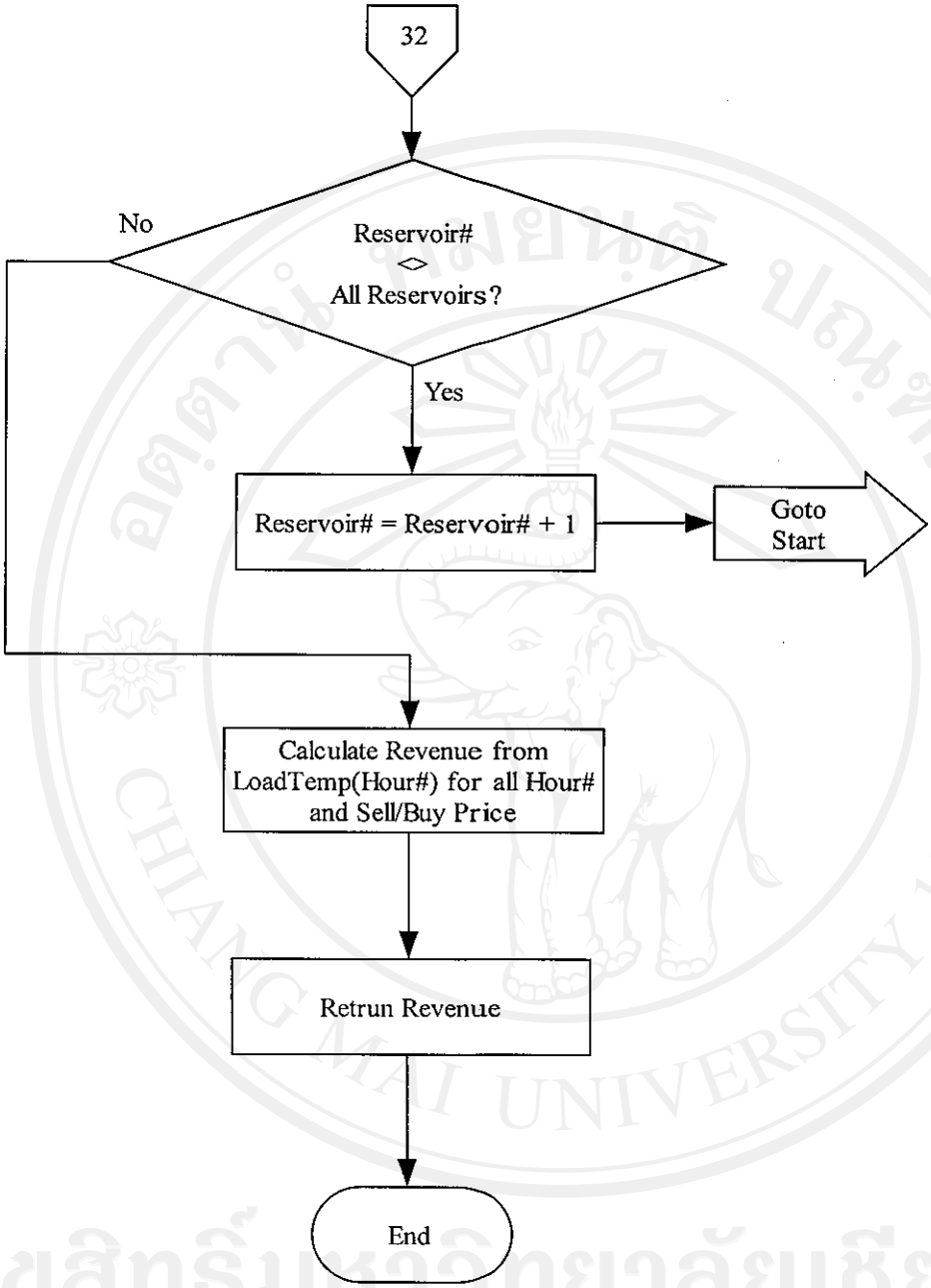

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Appendix B

Inflow Probability and Daily Load Profile

The Appendix B is divided into two appendixes B 1 and B2. The B 1 appendix is inflow probability of the Hydro power Plant reservoir which is already included in the Chapter 4 by making into graphs. The B 2 appendix is Daily Load profile for the whole year (12 months) this appendix is also included in the Chapter 4 by making into graphs too. The two Appendixes are shown into tables as below.

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B 1 : Inflow Probability of Hydro Power Plant Reservoir

Table B 1.1: Inflow Probability of Nam Ngum Reservoir (Unit: Million Cubic Meters)

(%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
0	386.17	326.79	539.48	561.32	1331.67	2382.51	4426.06	4717.47	4253.47	1955.26	1038.51	813.86	16773.41
2	363.65	320.01	350.09	535.30	1098.01	2245.81	3595.75	4681.84	3729.89	1929.97	1029.34	519.13	15960.24
4	350.60	317.28	292.88	432.92	1069.81	2178.27	3471.21	4116.70	3475.87	1842.58	760.49	500.99	15705.35
6	346.29	289.17	285.01	415.29	993.34	2154.29	3306.22	4087.24	3178.57	1808.46	742.87	494.65	15668.35
8	335.07	283.80	275.42	399.50	971.08	2010.25	3163.46	4063.13	2834.35	1799.99	737.76	464.70	15383.03
10	334.69	263.81	252.33	396.47	969.90	1981.90	3144.71	4030.99	2822.17	1722.75	722.31	448.77	15324.82
12	325.26	247.61	252.22	386.29	962.24	1973.99	3079.62	4003.40	2815.95	1706.62	705.59	435.61	14537.69
14	319.83	243.23	237.65	349.43	960.53	1964.04	2975.17	3899.48	2774.74	1628.57	671.69	427.82	14521.09
17	318.35	227.14	228.01	325.61	946.01	1935.16	2970.08	3812.97	2723.16	1545.76	658.21	419.17	14405.76
19	315.17	225.45	226.54	323.74	934.92	1918.78	2827.05	3411.48	2714.86	1513.89	655.34	414.46	14042.34
21	310.16	224.99	226.32	278.90	931.09	1900.04	2770.54	3143.10	2702.94	1470.12	646.00	405.62	13581.61
23	307.67	215.50	222.71	274.83	726.22	1877.33	2643.58	3076.41	2692.57	1453.35	635.17	405.27	13375.96
25	295.27	213.91	211.25	268.61	718.53	1776.63	2641.30	3053.38	2649.02	1421.88	617.16	404.81	13350.53
27	291.68	211.37	211.14	268.30	694.21	1746.23	2611.82	2846.07	2641.25	1421.35	602.93	395.20	13345.50
29	274.54	203.04	203.83	267.13	693.60	1694.52	2601.64	2815.27	2582.54	1408.70	600.39	388.74	13263.77
31	272.74	202.00	188.93	264.46	667.67	1691.75	2583.34	2775.09	2502.58	1396.81	593.15	386.65	12855.07
34	270.81	201.71	182.18	261.46	643.00	1690.58	2543.09	2741.88	2450.01	1322.51	591.86	376.56	12853.17
36	263.80	196.90	179.40	260.50	630.31	1659.81	2515.29	2706.79	2389.56	1314.83	584.94	356.17	12824.49
38	260.21	189.88	177.47	256.63	629.26	1623.58	2488.39	2692.60	2382.44	1244.79	582.45	350.58	12806.42
40	258.09	189.67	175.94	256.63	616.67	1605.33	2488.26	2681.08	2350.01	1209.67	577.16	346.56	12685.12
42	255.55	187.80	175.22	252.28	613.76	1557.33	2465.33	2671.17	2317.84	1189.72	563.32	339.62	12673.76
44	255.22	181.97	164.96	250.39	563.11	1549.03	2433.03	2670.87	2316.81	1161.25	563.19	329.18	12628.66
46	253.51	177.25	163.89	241.21	551.51	1545.17	2385.09	2664.77	2263.59	1155.46	562.36	325.61	12558.45
48	236.07	172.95	163.78	234.84	529.71	1523.50	2335.43	2663.13	2242.75	1143.89	561.01	325.48	12487.03
51	216.71	170.89	144.93	233.69	524.54	1435.66	2330.69	2623.76	2203.82	1080.49	552.17	315.54	12470.07
53	213.63	169.61	136.89	231.18	500.65	1368.47	2297.93	2616.05	2180.62	1076.18	551.19	309.27	12449.33

(%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
55	212.64	158.46	136.71	225.79	497.94	1350.77	2255.75	2595.05	2168.03	1045.27	545.56	295.45	12376.23
57	209.56	157.39	135.31	225.37	477.42	1343.28	2226.69	2590.49	2139.51	1029.74	537.24	293.15	12333.92
59	199.67	146.24	133.76	225.35	473.14	1279.33	2213.51	2586.26	2120.85	1023.47	532.63	292.37	12215.96
61	197.48	134.82	133.17	217.62	467.14	1251.94	2183.32	2570.67	2095.53	1013.88	528.15	288.20	12033.97
63	191.99	124.20	132.53	209.69	450.24	1198.07	2155.23	2563.18	2085.03	1010.56	519.05	282.12	11964.06
65	116.51	101.56	131.35	202.51	449.62	1190.48	2139.56	2558.54	2052.16	1002.53	503.70	281.42	11800.62
68	108.98	101.17	128.64	200.49	419.28	1165.39	2099.44	2547.08	1983.40	989.72	500.20	275.82	11494.76
70	105.15	85.74	126.50	195.59	414.54	1164.02	2001.97	2529.05	1970.91	978.39	498.73	250.97	11478.28
72	96.74	82.40	126.50	193.34	400.13	1131.49	2000.76	2515.53	1961.00	962.51	474.34	245.80	11470.22
74	93.37	79.13	118.55	184.01	399.70	1063.81	1987.05	2447.09	1952.86	932.40	471.02	242.90	11427.46
76	92.97	78.31	117.47	182.74	392.87	1026.87	1985.66	2426.28	1927.52	932.08	458.19	227.61	11242.42
78	89.51	76.93	113.78	182.37	388.90	1009.35	1955.04	2345.45	1843.90	925.68	454.71	222.41	11025.30
80	89.30	71.41	113.64	182.11	378.51	957.20	1859.13	2316.31	1716.16	866.92	430.63	194.08	10807.71
82	88.71	71.25	113.11	178.07	372.40	928.45	1834.49	2314.78	1601.36	863.81	422.88	158.05	10685.46
85	86.94	70.81	113.00	177.34	358.77	890.90	1793.46	2310.58	1594.49	826.29	412.36	152.70	10544.26
87	83.91	70.47	110.30	176.62	300.36	856.92	1749.88	2284.78	1593.12	823.10	410.78	137.13	10501.45
89	81.93	68.27	109.84	168.92	293.07	794.21	1719.80	2242.79	1592.45	792.65	394.50	123.42	10300.80
91	81.50	64.45	108.50	160.37	278.90	670.50	1506.28	2008.45	1509.17	785.63	392.25	118.95	9223.08
93	80.89	63.94	107.56	154.07	276.71	605.47	1495.83	1955.71	1504.60	721.32	382.29	115.52	9205.33
95	79.17	62.83	103.20	141.50	243.76	599.32	1414.62	1884.17	1386.38	649.35	354.20	112.44	9083.85
97	76.74	62.13	101.91	135.15	217.70	564.62	1253.49	1805.94	1374.15	620.56	354.04	109.47	8007.48
100	74.46	58.93	99.66	125.79	182.56	542.27	1083.65	1720.74	1213.24	598.38	304.09	95.94	7688.75
Average	**211.85**	**163.43**	**176.74**	**255.66**	**595.94**	**1428.64**	**2375.18**	**2841.35**	**2282.86**	**1194.15**	**562.25**	**317.00**	**12405.05**

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Table B 1.2: Inflow Probability of Nam Leuk Reservoir (Unit: Million Cubic Meters)

(%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
0	1.56	1.37	2.17	2.17	31.76	137.06	194.76	205.84	227.10	88.53	7.87	3.07	903.25
5	1.47	1.26	1.78	1.77	25.76	125.51	186.66	197.37	211.64	82.59	7.36	2.89	846.05
10	1.38	1.15	1.46	1.45	20.89	114.94	178.89	189.26	197.23	77.04	6.89	2.72	793.30
15	1.30	1.06	1.19	1.18	16.94	105.26	171.45	181.47	183.81	71.87	6.45	2.56	744.54
20	1.23	0.97	0.98	0.97	13.74	96.39	164.31	174.01	171.30	67.05	6.03	2.41	699.37
25	1.15	0.90	0.80	0.79	11.14	88.27	157.48	166.85	159.64	62.54	5.64	2.27	657.47
30	1.09	0.82	0.66	0.65	9.04	80.84	150.92	159.99	148.77	58.34	5.28	2.13	618.52
35	1.02	0.76	0.54	0.53	7.33	74.03	144.64	153.41	138.64	54.43	4.94	2.01	582.27
40	0.96	0.69	0.44	0.43	5.94	67.79	138.62	147.10	129.20	50.77	4.62	1.89	548.47
45	0.91	0.64	0.36	0.35	4.82	62.08	132.86	141.05	120.41	47.36	4.32	1.78	516.94
50	0.85	0.59	0.30	0.29	3.91	56.85	127.33	135.25	112.21	44.18	4.05	1.67	487.47
55	0.80	0.54	0.24	0.24	3.17	52.06	122.03	129.68	104.57	41.22	3.79	1.58	459.92
60	0.76	0.50	0.20	0.19	2.57	47.68	116.95	124.35	97.45	38.45	3.54	1.48	434.12
65	0.71	0.46	0.16	0.16	2.08	43.66	112.09	119.24	90.82	35.87	3.31	1.40	409.95
70	0.67	0.42	0.13	0.13	1.69	39.98	107.42	114.33	84.64	33.46	3.10	1.31	387.29
75	0.63	0.38	0.11	0.11	1.37	36.61	102.95	109.63	78.88	31.21	2.90	1.24	366.03
80	0.59	0.35	0.09	0.09	1.11	33.53	98.67	105.12	73.51	29.12	2.72	1.16	346.06
85	0.56	0.32	0.07	0.07	0.90	30.70	94.56	100.80	68.50	27.16	2.54	1.10	327.30
90	0.53	0.30	0.06	0.06	0.73	28.12	90.63	96.65	63.84	25.34	2.38	1.03	309.66
95	0.49	0.27	0.05	0.05	0.59	25.75	86.86	92.68	59.49	23.64	2.22	0.97	293.07
100	0.47	0.25	0.04	0.04	0.48	23.58	83.24	88.86	55.44	22.05	2.08	0.91	277.46

Table B 1.3: Inflow Probability of Nam Dong Reservoir

(Unit: Million Cubic Meters)

(%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
0	1.87	1.22	1.02	1.08	1.18	2.62	3.56	4.80	5.08	5.54	5.82	3.39	37.19
5	1.81	1.18	0.99	1.05	1.14	2.41	3.42	4.69	4.97	5.37	5.61	3.22	35.87
10	1.75	1.15	0.97	1.01	1.10	2.22	3.27	4.57	4.87	5.20	5.40	3.06	34.58
15	1.68	1.11	0.94	0.98	1.07	2.05	3.14	4.45	4.77	5.03	5.19	2.91	33.32
20	1.62	1.07	0.91	0.94	1.03	1.89	3.01	4.34	4.67	4.86	4.99	2.76	32.09
25	1.56	1.04	0.89	0.91	0.99	1.74	2.88	4.22	4.57	4.69	4.78	2.63	30.88
30	1.49	1.00	0.86	0.87	0.95	1.60	2.76	4.10	4.46	4.53	4.57	2.49	29.69
35	1.43	0.97	0.83	0.83	0.91	1.47	2.65	3.99	4.36	4.36	4.36	2.37	28.53
40	1.36	0.93	0.81	0.80	0.88	1.36	2.54	3.87	4.26	4.19	4.15	2.25	27.39
45	1.30	0.89	0.78	0.76	0.84	1.25	2.43	3.75	4.16	4.02	3.94	2.14	26.27
50	1.24	0.86	0.76	0.73	0.80	1.15	2.33	3.63	4.06	3.85	3.73	2.03	25.17
55	1.17	0.82	0.73	0.69	0.76	1.06	2.23	3.52	3.95	3.68	3.53	1.93	24.08
60	1.11	0.78	0.70	0.66	0.72	0.98	2.14	3.40	3.85	3.51	3.32	1.84	23.01
65	1.05	0.75	0.68	0.62	0.69	0.90	2.05	3.28	3.75	3.34	3.11	1.75	21.96
70	0.98	0.71	0.65	0.59	0.65	0.83	1.97	3.17	3.65	3.17	2.90	1.66	20.92
75	0.92	0.67	0.62	0.55	0.61	0.77	1.88	3.05	3.55	3.00	2.69	1.58	19.89
80	0.86	0.64	0.60	0.51	0.57	0.70	1.81	2.93	3.44	2.83	2.48	1.50	18.87
85	0.79	0.60	0.57	0.48	0.53	0.65	1.73	2.82	3.34	2.66	2.28	1.42	17.87
90	0.73	0.56	0.54	0.44	0.50	0.60	1.66	2.70	3.24	2.49	2.07	1.35	16.88
95	0.67	0.53	0.52	0.41	0.46	0.55	1.59	2.58	3.14	2.32	1.86	1.29	15.90
100	0.60	0.49	0.49	0.37	0.42	0.51	1.52	2.46	3.04	2.15	1.65	1.22	14.93

B 2. Load profile twenty four hours

Table B.2.1 Daily Load Profile of EDL Central-I Area for January (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	51	50	50	50	52	59	70	68	73	74	76	73	71	73	75	73	73	84	100	92	85	76	64	57
Saturday	52	51	48	51	52	58	66	67	74	74	73	66	67	69	70	70	70	80	100	91	83	75	65	59
Sunday	56	55	54	55	56	60	64	67	67	66	65	63	61	65	61	62	66	79	100	92	83	74	62	57

Table B.2.2 Daily Load Profile of EDL Central-I Area for February (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	52	52	51	51	53	59	68	67	75	77	79	77	77	82	84	80	76	79	100	96	88	78	67	59
Saturday	56	54	53	53	56	60	66	70	76	75	76	72	72	74	75	75	70	74	100	94	87	79	71	62
Sunday	58	57	54	55	56	61	65	66	66	65	62	64	64	64	65	65	68	73	100	95	89	79	70	63

Table B.2.3 Daily Load Profile of EDL Central-I Area for March (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	56	55	54	54	55	61	66	68	79	82	84	82	83	86	86	81	76	79	100	96	92	85	75	67
Saturday	64	60	59	59	61	64	68	72	78	78	78	76	74	76	77	76	76	87	100	96	91	88	75	67
Sunday	61	59	58	58	60	68	67	68	69	68	67	69	67	69	69	67	71	78	98	100	94	87	74	66

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Table B.2.4 Daily Load Profile of EDL Central-I Area for April (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	63	62	60	60	60	63	62	66	81	83	86	84	84	87	87	83	78	76	99	100	98	94	84	76
Saturday	66	64	63	62	62	67	60	68	72	69	70	70	70	72	73	72	68	69	98	95	100	96	89	81
Sunday	69	67	66	65	65	65	64	62	62	62	64	63	65	66	67	67	64	74	98	100	99	93	84	77

Table B.2.5 Daily Load Profile of EDL Central-I Area for May (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	62	60	60	59	60	62	61	67	82	85	88	84	85	90	90	84	77	75	97	100	97	90	81	72
Saturday	67	65	60	59	57	62	60	64	72	72	73	70	70	71	72	70	67	69	96	100	96	89	81	74
Sunday	69	68	68	67	67	66	64	62	64	63	63	62	62	63	63	61	64	65	88	99	100	94	84	77

Table B.2.6 Daily Load Profile of EDL Central-I Area for June (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	61	60	58	58	58	61	63	68	84	86	87	83	84	89	89	83	76	75	94	100	97	90	79	71
Saturday	64	62	61	67	60	61	62	67	74	75	75	74	73	76	75	73	70	68	89	100	97	94	82	77
Sunday	71	69	67	66	66	66	60	64	66	66	67	67	67	68	68	66	67	73	90	100	100	95	84	77

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Table B.2.7 Daily Load Profile of EDL Central-I Area for July (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	61	60	59	58	59	63	63	71	84	88	89	85	86	89	90	86	77	80	94	100	97	89	80	72
Saturday	67	67	66	66	66	67	67	69	82	82	83	78	76	79	78	76	73	76	94	100	97	91	83	75
Sunday	70	69	68	68	68	69	66	68	69	74	79	73	69	69	69	69	71	76	95	100	96	91	82	73

Table B.2.8 Daily Load Profile of EDL Central-I Area for August (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	62	60	59	58	59	61	63	69	83	86	88	83	83	88	89	83	75	75	100	100	97	89	79	70
Saturday	62	61	60	60	60	62	63	68	76	76	76	73	72	73	72	70	69	70	97	100	97	93	81	75
Sunday	65	63	61	61	63	64	65	62	67	67	66	65	64	64	60	64	66	75	99	100	95	89	81	71

Table B.2.9 Daily Load Profile of EDL Central-I Area for September (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	57	56	55	54	57	60	63	62	76	78	79	77	76	81	81	77	72	75	100	94	90	83	73	64
Saturday	63	60	59	58	60	64	63	63	72	73	74	71	69	73	71	69	68	77	100	94	90	82	73	61
Sunday	58	57	57	57	61	61	65	62	67	69	70	70	68	69	70	68	67	77	100	99	94	86	75	66

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Table B.2.10 Daily Load Profile of EDL Central-I Area for October (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	57	55	54	54	56	62	63	67	81	82	85	80	82	86	87	82	77	90	100	98	92	85	75	66
Saturday	66	64	63	63	63	67	67	71	79	78	80	74	75	77	77	75	72	92	97	100	96	91	80	74
Sunday	67	64	62	63	63	64	63	63	65	64	65	63	61	61	61	61	64	84	100	99	94	86	76	67

Table B.2.11 Daily Load Profile of EDL Central-I Area for November (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	53	51	51	51	54	60	64	62	72	75	78	75	75	80	80	78	76	95	100	93	87	77	68	60
Saturday	62	60	60	60	61	65	66	70	76	77	77	73	72	76	76	74	72	94	100	95	88	82	72	65
Sunday	61	58	58	57	59	63	62	62	62	61	61	60	60	59	59	60	67	96	100	92	86	78	67	61

Table B.2.12 Daily Load Profile of EDL Central-I Area for December (Unit: %)

Hours ⇒	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	52	51	51	51	53	60	66	65	75	77	80	77	76	80	82	79	77	94	100	93	85	77	66	58
Saturday	51	50	50	49	51	55	61	64	73	74	73	68	70	74	75	76	74	92	100	94	84	76	66	59
Sunday	55	55	54	54	56	60	63	63	67	67	69	66	66	67	68	70	70	91	100	93	86	77	66	59

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Curriculum vitae

Name and family Name:	PHOUMMY NETIBANEDITH
Date and Place of Birth:	20 March 1958 at Phonemy Village, Viengkham District Vientiane Province
Education:	From 1964 to 1970 studied at primary school in Phone my Village, 1970 to 1974 studied at secondary school in Viengkham District Vientiane Province. From 1974 to 1977 studied at high school in Vientiane municipality From 1977 to 1983 studied at Polytechnic Institute of Doetsk in Ukrain state former Soviet Union (Ukrain country in present), obtained diploma of electrical engineering. From 6 August to 7 September 1990 had participated in and completed the International Training Program in the field of Power System Control and Operation at Royal Institute of Technology in Sweden. From 4-6 June 1996 had participated in the training workshop on Power System Dynamics, Control and Operation at Asian Institute of Technology Bangkok, Thailand. From 4 May to 12 June had participated in the training course on Integrated Watershed Management at Asian Institute of Technology Bangkok, Thailand. From 21 July 2002 to 27 March 2006 studied at Chiang Mai University
Employment History:	From 1983 to 1986 worked at High voltage distribution Department of EDL, in charge of maintenance and installation electric station and sub-station. From 1986 to 1997 worked at Nam Ngum Hydropower Plant were deputy and manager of Generation and Operation Department. From 1997 to 2002 was deputy manager of Nam Ngum Hydropower Plant in charge of Operation and Maintenance work. From 2002 up till now has been a manager of Nam Ngum Hydropower Plant.

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